SCIENCE ABSTRACTS.

Section A.—PHYSICS.

JANUARY, 1927.

GENERAL PHYSICS.

1. *Report of the Eighteenth National Conference on Weights and Measures of the United States.* (Bureau of Standards, Misc. Publ. No. 70. [187 pp.], 1926.) See also Abstract 2879 (1924).

2. *Short Tests for Sets of Laboratory Weights.* **A. T. Pienkowsky.** (Bureau of Standards, Sci. Papers, No. 527, pp. 65–93, 1926.)—Three kinds of tests are outlined: First, rough checks for gross errors such as can be detected by simply checking duplicate weights against each other or by comparing a few weights with the sum of those smaller weights whose sum equals the larger weight; second, the comparison with each other of just enough weights and combinations of weights so that the value of each weight can be computed from a standard weight the size of the largest weight in the set; third, the comparison of a sufficient number of weights or combinations so that the agreement of various results will serve as a check against any serious mistake in the observations. If no standards are available, "relative" values may be found with practically no change in the procedure. The effect of inequality of the arms of the balance beam is eliminated by the method of combining the weighings. Therefore ordinary "direct" methods of weighing may be used. All multipliers and divisors have been reduced to one figure, and the numbers used in the computations need seldom be larger than three significant figures. Numerical examples illustrate the computations. Every detail of the computations is indicated in full, even though this adds somewhat to the apparent complexity. An accuracy sufficient for most work can be obtained without detailed corrections for the buoyant effect of the air by attention to the notes given on this subject. AUTHOR.

3. *Review of the Literature relating to the Normal Densities of Gases.* **Marion S. Blanchard** and **S. F. Pickering.** (Bureau of Standards, Sci. Papers, No. 529, pp. 141–177, 1926.)—This paper consists of a review of the literature on the normal densities of gases wherein the attempt is made to choose the most reliable value for each gas. The number of sources of the gas in question, the methods used for its purification, the precautions observed in making the experimental measurements, the number of observations made, the agreement between observations of a set and the concordance between the results of the different observers have all been carefully considered in the selection of the final value. While many of the early determinations of historical interest have been included, in general only those which should be considered in selecting the final value have been critically reviewed. AUTHORS.

4. *Invariable Pendulum of Tungsten for Relative Measurements of Gravity.* **H. Nagaoka.** (Imp. Acad. Tôkyô, Proc. 2. pp. 198–200, May, 1926. In English.)—A brief description is given of a pendulum made entirely (*i.e.* including knife-edges, rod and bob) of tungsten. The following advantages are claimed: The density of tungsten is 2·3 times that of brass and 2·4 times that of invar, so that the pendulum can be made in a compact form without losing the necessary weight; the tensile strength being 9 times that of brass, a slender rod can be used for supporting the bob; the thermal expansion being only 0·26 that of brass, there is little risk of incurring an error due to temperature variation, which is the most important factor in the measurement; tungsten is very hard and can therefore be made into a good knife-edge; unlike brass or invar, the metal is insoluble in HCl, H_2SO_4 or HNO_3, and the risk of deterioration of the surface is much lessened. The tungsten knife-edge is arranged to rest on a plane face of stellite No. 23, which is a little harder than tungsten. Owing to the compactness of these pendulums and their vibration cases (about 30 cm. long and 15 cm. diam.) there is great facility in the transport of the gravity apparatus. The correction for the yielding of the support was found to be 2 units in the 7th decimal of a second. A. B. W.

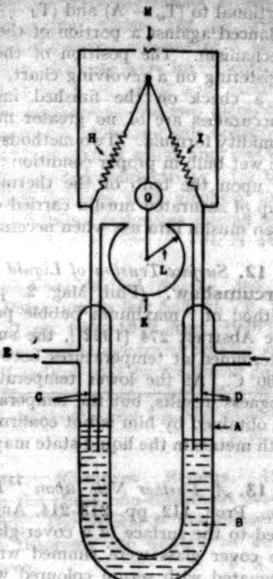
5. *Pendulum Apparatus for Gravity Determinations.* (Engineering, 122. pp. 271–272, Aug. 27, 1926.)—The apparatus, which was designed by G. Lenox-Conyngham, and is manufactured by the Cambridge Instrument Co., is a modification of that used by Meinesz, but only three pendulums are employed, all of which oscillate in the same plane. Three half-second pendulums, of solid nickel steel with a very small temperature coefficient, are contained in an evacuated chamber. They are mounted on parallel stellite knife-edges, the latter being polished in the centre to form mirrors. A beam of light falls upon each of the outer pendulums, and is reflected on to the centre one, where it is again reflected on to the camera. The oscillations of the reflected beams are those given by imaginary pendulums of phase angles equal to the difference between the phase angles of the outer and centre pendulums. The light is flashed at intervals slightly less than twice the period of the pendulums, consequently the trace becomes a sine curve of amplitude equal to that of the hypothetical pendulums. Owing to the difference in phase between the outer and the middle pendulums being unaffected by the horizontal acceleration of the chamber as a whole, the instrument can be used when a perfectly stable support is not available. A. W. L.

6. *Manometer for Measuring Low Pressures.* **T. Shirai.** (Chem. Soc. Japan, Bull. 1. pp. 109–115, June, 1926. In English.)—The instrument consists of a thermometer enclosed in a tube. The pressure is found by measuring the time required to cool the thermometer over a given small range of temperature under given conditions. Using a thermometer with a long cylindrical bulb and with a narrow operating range of temperature, the pressure may be calculated from a simple formula for which both experimental and theoretical bases are given.

A. A. D.

7. *Recording Small Pressure Differences.* **I. B. Smith.** (Optical Soc. America, J. and Rev. Sci. Inst. 12. pp. 655–657, June, 1926.)—Two platinum wires are sealed into each limb of a **U**-tube which is partially filled with an electrolyte. The resistance coils H and I and the platinum wires, together with portions of the slide wire K, constitute a Wheatstone bridge. The difference in pressure between E and F manifests itself in a difference of level of the liquid in the two arms of the **U**-tube, and a proper calibration of the slide wire K serves to measure the pressure difference.

W. C. S. P.



8. *Pressure Effects on the Movement of Watches.* **A. Jaquerod.** (Arch. des Sciences, 8. pp. 93–120, May-June, 1926.)—The movement of the balance-wheel of a watch is affected by pressure in two ways: (1) Directly by the entrainment of air, thus increasing the inertia; (2) indirectly by the frictional diminution in the amplitude of the oscillations. The behaviour of various watches, under pressures ranging from 15 mm. to 3000 mm. of mercury, has been studied by observations of the movement, the amplitude of oscillations, and of isochronism; the two former effects were measured in air, hydrogen, and carbon dioxide. The direct effect is found to be proportional to the product of the density and the viscosity. The coefficient for change in period per unit change in pressure must be determined for each case individually; cited values range from 0·006 to 0·02 sec. per mm.

A. W. L.

9. *New Design of Apparatus for the Study of Rotational Forces.* **P. E. Klopsteg.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 107–115, July, 1926.)—Describes a centripetal force apparatus designed specially for teaching purposes.

E. G.

10. *Apparatus for Reproducing Curves with a Wave Projection Machine.* **F. Strieder.** (Phys. Zeits. 27. pp. 539–541, Aug. 15, 1926.)—A full description is given of the details of two forms of apparatus and their method of use. With the latter type several sources of error, which existed in the earlier form, are avoided and accurate sine-wave curves can be obtained [see Abstract 1494 (1926).]

R. S. R.

11. *New Relative Humidity Recorder.* **L. Behr.** (Optical Soc. America, J. and Rev. Sci. Inst. 12. pp. 623–653, June, 1926.)—It is shown that the relation between wet and dry bulb temperatures for constant relative humidity may be expressed in the form: Humidity $= (T_w - A)/(T_d - B)$, where B is a constant, and A depends upon the humidity but only changes slightly with it. Nickel resistance thermometers are used in circuits designed to record potential differences proportional to $(T_w - A)$ and $(T_d - B)$; the latter potential is automatically balanced against a portion of the former by a motor-governed recording mechanism. The position of the balance point, as recorded by a pen registering on a revolving chart, gives the humidity record. The results of a check on the finished instrument show that any instrumental inaccuracies are of no greater magnitude than the uncertainties in the humidity formula. Two methods have been found satisfactory for keeping the wet bulb in proper condition: (1) An atomiser which blows saturated air upon the bulb of the thermometer; (2) covering the bulb with a strip of saturated muslin carried on rollers which can be rotated to bring clean muslin into use when necessary. A. W. L.

12. *Surface Tension of Liquid Metals. Part I. Tin and Lead.* **L. L. Bircumshaw.** (Phil. Mag. 2. pp. 341–350, Aug., 1926.)—Using the method of "maximum bubble pressure," as first employed by Hogness [see Abstract 274 (1922)], the surface tensions of liquid Sn and Pb are determined at temperatures between their respective melting points and 1000° C. At the lower temperatures good agreement is obtained with Hogness' results, but the temperature coefficient of the surface tension of Sn obtained by him is not confirmed. Evidence is adduced to show that both metals in the liquid state may be highly associated. A. B. C. L.

13. *A Further Note upon "Intertraction."* **A. E. Wright.** (Roy. Soc., Proc. 112. pp. 213–214, Aug. 3, 1926.)—A disc of filter-paper was fixed to the surface of a cover-glass of larger diameter, and the edges of the cover glass were rimmed with paraffin. The filter-paper was impregnated with serum coloured with an aniline dye, and the cover-glass was floated in a watch-glass of hypertonic salt solution a little denser than the serum. The outward streaming effects characteristic of intertraction appeared almost immediately; they took place horizontally over the surface, while in previous experiments they had only been observed in a vertical direction. H. N. A.

14. *Liquid Drops which Swim on the Surface of the Same Liquid.* **M. Katalinić.** (Zeits. f. Physik, 38. 6–7. pp. 511–512, 1926.)—Uses a freshly prepared solution of the sodium salt of fluorescein in water to which some gelatine has been added; drops with a diameter up to 6 mm. have been observed swimming on the surface, and velocities of from 10 to 30 cm. per sec. have been seen. H. N. A.

15. *Viscosities of Several Aqueous Solutions of Organic Substances and the Polymerisation of Water.* **H. M. Chadwell.** (Am. Chem. Soc., J. 48. pp. 1912–1925, July, 1926.)—The values of the viscosities and densities at 25° are given for solutions of methyl acetate in ethyl acetate, methyl acetate in water, water in methyl acetate, ethyl acetate in water, water in ethyl acetate, ethyl ether in water, and benzene in

V.3
192

water. The results show that aqueous solutions of non-polar material possess viscosities greater than that of water, even though the solute itself has a lower viscosity. Parallelism exists between the degree of contraction and the increase in viscosity accompanying solution. The data are considered in connection with the polymerisation of water and the internal pressures concerned. T. H. P.

16. *Viscosity Measurements for Solutions in Ethyl and Methyl Alcohols.* **H. Goldschmidt** and **H. Aarflot.** (Zeits. phys. Chem. 122. pp. 371–382, Aug. 20, 1926.)—This paper contains a detailed account of a very extended series of experiments in which the following were investigated: (1) the change in viscosity by addition of water to ethyl and methyl alcohols; (2) the viscosities of electrolytic solutions in the two alcohols; (3) the influence of water on the viscosities of acids and salt solutions in the two alcohols; (4) the viscosities of mixtures of ethyl and methyl alcohols, and the relationship between viscosity and conductivity; (5) the viscosities of solutions of certain bases and acids in both alcohols, and the changes which the viscosity of acid solutions undergoes during salt formation. H. H. Ho.

17. *Viscosities and Densities of Anhydrous Methyl Alcohol and of Solution of Some Halides of Sodium and Potassium in this Solvent.* **F. K. Ewart** and **H. R. Raikes.** (Chem. Soc., J. pp. 1907–1912, Aug., 1926.)—The results are given of detailed measurements of the viscosity and density of the chlorides, bromides, and iodides of sodium and potassium in carefully purified methyl alcohol at 25° C. The presence of water is found to increase the viscosity of methyl alcohol, while acetone has the opposite effect. J. N. P.

18. *Hydrodynamics.* **A. Rosenblatt.** (Comptes Rendus, 183. pp. 489–490, Sept. 6, 1926.)—A note on the plane non-rotational movements in an incompressible viscous fluid. The article is mathematical and unsuitable for abstracting. Three theorems are quoted as being deduced from the analysis previously given. F. S. B.

19. *Oscillations of a Liquid in Communicating Vessels.* **R. Mazet.** (Accad. Lincei, Atti, 3. pp. 673–679, June 3, 1926.)—Oscillations of fluid contained in two vessels connected by an orifice at the base, and whose sides are vertical in the neighbourhood of the free surfaces, were investigated, the motion being taken as two-dimensional and the usual methods of conformal transformation used. Mainly mathematical. W. G. B.

20. *Critical Flow Velocity in a Circular Tube.* **H. Lorenz.** (Phys. Zeits. 27. pp. 533–536, Aug. 15, 1926.)—This paper extends the author's previous paper on the turbulence problem [see Abstract 2422 (1925)]. For evaluating the critical flow velocity, a new boundary condition is derived from the energy equation. The result obtained is in good agreement with Schiller's latest experimental value. The paper is entirely mathematical. H. H. Ho.

21. *Theory of Turbulent Currents in Tubes.* **A. Pröll.** (Zeits. techn. Physik, 7. 9. pp. 428–434, 1926.)—The investigations of Kárman, Lorenz [see Abstract 2422 (1925)], and Mohorovičič on the laws of turbulent motion are first discussed. Based on the Lorenz procedure for setting up a turbulence theory, the author first derives generally the equations for the connection of the resistance values λ with the Reynold numbers, and then makes application to Mohorovičič's proposed velocity distribution of the flow in the tube. It is shown that for the larger Reynold numbers, a moderate agreement with the experimental results and the Lorenz formula can be attained, but that for the transition to feebly turbulent and finally laminated flows a steady velocity distribution law does not suffice to include the whole of the phenomena. A calculation is given for the average value of the turbulent fluctuation velocity.

H. H. Ho.

22. *Retention of a Ball by a Vertical Water-Jet.* **W. C. Baker.** (Science, 64. pp. 161–163, Aug. 13, 1926.)—A ball, mounted on a horizontal axis, the horizontal pull on which is measured by a delicate spring device, and provided with vertical slides on which the water can impinge on leaving the ball, shows the following facts. When the ball is at such a height that its weight is balanced by the vertical thrust of the jet and the slides are drawn to allow free passage for the water leaving the ball, the ball is acted on by a horizontal force varying with the point of impact, increasing to a maximum of about half the weight of the ball if the latter is allowed to rotate freely about its horizontal axis. The force is lessened by about 40 % if the ball is fixed. If the slides are closed, the impact of water on them entirely neutralises this horizontal pull. It is concluded that the force is entirely due to the creation of a horizontal momentum component, and that the law of Bernoulli plays a very small part in causing it.

W. G. B.

23. *Studies in Adhesion. Part I.* **W. Hardy** and **Millicent Nottage.** (Roy. Soc., Proc. 112. pp. 62–75, Aug. 3, 1926.)—Experiments are carried out in which the adhesion between cylinders and plates, ground to optical faces, of copper, steel and glass, separated by "lubricants," such as, for example, octane, ethyl alcohol, *p*-cymene, is determined at various temperatures. Previous measurements by Budgett [see Abstract **430 (1912)**] are referred to. It is found that for fluid lubricants, given sufficient time, the minimum force required to lift the cylinder is that necessary to overcome the surface tension of the lubricant, but that an identifiable limiting value ("Value A") is obtainable for the adhesion recorded when the cylinder is broken away instantaneously from the equilibrium position in which the initial load is borne by the Leslie pressure. The latent period which elapses before this state is reached is due either to orientation of the molecules of the lubricant or to motion of the cylinder in the pool of lubricant. Value A is found to be greatest with glass, least with copper. It is also a function of the chemical constitution of the lubricant, of the initial load, and of temperature.

A. B. C. L.

24. *Determination of the Modulus of Elasticity by Dynamical Methods.* **H. W. Swift.** (Phil. Mag. 2. pp. 351–368, Aug., 1926.)—Treats mathematically and experimentally the methods of determining Young's modulus by means of the flexural vibrations of rods or beams supported at or near the ends, or clamped at one end, with the beam either horizontal or vertical, and by means of the oscillations of wires in span with a central load. The experiments with copper, iron, duralumin and brass give definite support to the view that truly elastic strain is quite independent of the permanent set and of the strain which manifests itself in elastic after-action, so that the elastic and non-elastic components of strain can be separated experimentally by the new methods. Apparently elasticity is a definite inherent property of materials, which is practically unaffected by the elastic history and condition of the specimen. The paper contains a number of tables giving the numerical results obtained with the different materials tested, which included ordinary and annealed copper bars, joists, channels, angles and tees of steel, and annealed wires of iron and of copper. H. N. A.

25. *Elastic Deformation of Thick Plates.* **C. A. Garabedian.** (Comptes Rendus, 183. pp. 416–418, Aug. 17, 1926.)—This is the continuation of a former paper by the author [Abstract 1296 (1925)] in which he applies the series method there developed to obtain a number of solutions already well known and others which appear to be new. G. W. DE T.

26. *Effect of Tension on Certain Elastic Properties of Wires.* **E. Edwards, I. Bowen** and **S. Alty.** (Phil. Mag. 2. pp. 321–340, Aug., 1926.)—This paper records an attempt to ascertain the nature of the mechanism involved in the increased torsional stiffness of phosphor-bronze strips consequent on increased tensions [see Abstract 904 (1913)]. Part I describes a statical method which was found more accurate than the usual dynamical procedure, and by which materials of simple internal structure have been tested. Observed changes in the elastic properties of materials were found to depend on a partial amorphous-crystalline structure and to be most marked when the crystals are small. The stress due to a tension may be regarded as equivalent to a hydrostatic negative pressure (*i.e.*, an outward pull), together with two shearing stresses in two perpendicular planes, both of which pass through the axis of the wire. Of these the first is considered responsible for the observed effect in so far as volume changes are concerned. Other experiments have shown that slip occurs readily in crystals along certain planes. The fact that a wire of single crystal does not exhibit any variation tends to lead to the view that the crystals in the interior of a multicrystalline material are not in the same condition as in a single large crystal, a difference due to the intercrystalline amorphous material. A hydrostatic pressure on the crystals might conceivably account for the effect, provided such a pressure resulted in greater freedom of slip within the crystals. Experiments are now in progress to test this view-point, which, if established, would clarify ideas with respect to the mechanism involved in the increase of stiffness and decrease of damping and hysteresis. H. H. Ho.

27. *Propagation of Rayleigh Waves in Two Dimensions.* **K. Sezawa.** (Imp. Acad. Tôkyô, Proc. 2. pp. 314–317, July, 1926. In English.)—First the author gives the equations of motion of elastic bodies in cylindrical coordinates when the circumferential component of the motion is omitted, solving them in terms of a Bessel's function Y of the second kind due to Nielsen. From displacement considerations he obtains an equation of the same form as Rayleigh's equation for the determination of the velocity of propagation of plane surface waves. He finds that the motion near the origin within a radial range of, say, 1/4 wave-length consists mainly of stationary oscillations, the type being: $u_0 = D(z)Y_1(kr) \cos pt$ and $\omega_0 = D'(z)Y_0(kr) \sin pt$. The line $r = 0$ must, of course, be excluded from consideration. Such a motion, however, quickly disappears as the distance from the origin increases. Even at a radial distance of two or three wave-lengths the motion may be regarded as that at infinity. The paper is entirely mathematical. H. H. Ho.

28. *Interior Ballistics.* **Gossot and Liouville.** (Comptes Rendus, 183. pp. 503–504, Sept. 13, 1926.)—In the treatment of interior ballistics the equations derived are:

$$\tfrac{1}{2}\xi\frac{d\omega}{d\xi} = F_1(\gamma) - \Gamma\omega,$$

$$\omega\tfrac{1}{2}\frac{d\gamma}{d\xi} = \left(\frac{1}{2}\cdot\frac{d\omega}{d\xi}\right)^{N},$$

where Γ, N are known; γ, ω, ξ are variables. To calculate the point of maximum pressure these are reduced to the form:

$$[F_1(\gamma) - \Gamma\rho^2]\frac{d^2\gamma}{d\rho^2} + (1 - N)\left[F_1'(\gamma)\left(\frac{d\gamma}{d\rho}\right)^2 - (1 + 2\Gamma)\frac{d\gamma}{d\rho}\right] = 0.$$

This is integrated by successive approximations, the third being fairly exact. The maximum pressure agrees well with the experimental value, but is predicted earlier than is found in practice. The discrepancy is probably due to an unwarranted mechanical simplification assumed implicitly in the original equations. A. Wh.

29. *Significance of Canonical Equations in Dynamics.* **G. D. Birkhoff.** (Comptes Rendus, 183. pp. 516–519, Sept. 20, 1926.)—If the functions X_i ($i = 1, \ldots, n$) of the n variables $x, \ldots, x_n$ are real and analytical, and if t denotes the time, then the differential system $dx_i/dt = X_i$ defines the motion of a fluid in the space of the variables x_i. It is evident that every movement of this kind in the vicinity of any point where the velocity is not zero, is equivalent to every other movement by means of a suitable transformation. The situation is entirely different either in the vicinity of a point where all the X_i's are zero (equilibrium case) or in the neighbourhood of a closed trajectory (periodicity). In the present paper the former and more simple case is considered. The conditions for stable equilibrium are first discussed, and the variables shown to be given by trigonometric series, whereas more general series are required for the unstable case. A primary criterion for trigonometric perturbations is shown to be the existence of certain integrals commencing with special quadratic terms. Further, a principle of variation is also shown to be necessary and sufficient for trigonometric perturbations, and by a suitable choice of dependent variables the equations are presented in canonical form. Poincaré has previously shown that the canonical form always signifies trigonometric perturbations, and it is the inverse situation which is now emphasised. H. H. Ho.

30. *Action in Parabolic Paths under Gravity.* **W. B. Morton.** (Phil. Mag. 2. pp. 800–805, Oct., 1926.)

31. *Analytical Exercise of the Motion of a Rigid Body in Four-Dimensional Space.* **F. Schottky.** (Preuss. Akad. Wiss. Berlin, Ber. 19.

pp. 215–241, 1926.)—In this paper the author extends the Euler problem of the motion of a rigid body to four-dimensional space, obtaining six instead of the three Euler rotation components which possess similar equations to the Euler trio. These differential equations have a simple form when each component $p_{\alpha\beta}$ has attached to it the corresponding moment of inertia $A_\alpha + A_\beta$. If the product be termed $q_{\alpha\beta}$, one of the equations is $dq_{12} = (a_1 - a_2)\{q_{14}q_{24}(a_3du + dv) + q_{13}q_{23}(a_4du + dv)\}$, where a_1, a_2, a_3, a_4 are the squares of the four moments of inertia A_α; u and v are linear functions of the time, *i.e.*, quantities which change with constant velocity. These equations are not in contradiction if u and v be not regarded as functions of t, but are regarded as two independent complex variables. They also agree with those differential equations satisfied by the six quotients $\vartheta_{\alpha\beta}/\vartheta$ of seven theta functions of two variables $\vartheta_5\vartheta_{12} \ldots \vartheta_{34}$, when definite constant factors are separated from these θ functions, making them a species of σ functions. A remarkable circumstance is that when the differential equations are set up for these six θ functions with a common denominator, the equations then define more general functions which contain essentially four parameters. The author now discusses these equations from a purely analytical standpoint, quite apart from mechanics and hypermechanics, and in particular the four algebraic equations between the $q_{\alpha\beta}$ which are derived from them. The paper is entirely mathematical. H. H. Ho.

32. *The Constitution of Mixture Crystals.* **T. Barth** and **G. Lunde.** (Zeits. phys. Chem. 122. pp. 293–334, Aug. 9, 1926.)—A review of the present views of several experimenters on the subject, together with an account of the authors' work on mixture crystals of various pairs of halogen compounds of Cu, Ag and Tl. The difference between the lattice constants in the case of the halogen compounds of the monovalent heavy metals can be considerably greater than in that of the alkali metals without rendering a regular mixture series impossible. No X-ray interferences were found such as would be produced by a "normal" or regular distribution of the components in the lattice. The lattice constant of cubical mixture crystals can be calculated from the equation of Grimm and Vegard. In many cases, however, there is no such simple law. But often, by investigating the mixture crystals of compounds of different lattice types, it is possible by extrapolating to calculate the constants of an unstable lattice type of one of the components. The colours of the mixture crystals of CuI–AgI, AgBr–AgI and TlBr–TlI are deeper than those of the pure components. From this an idea of the mutual influence of the ions on each other in the mixture crystals can be gained. Details are given of the results of X-ray examinations involved in the investigation. H. N. A.

33. *Parameters in Crystal Structure. The Mercurous Halides.* **R. J. Havighurst.** (Am. Chem. Soc., J. 48. pp. 2113–2125, Aug., 1926.)—In the determination of parameters in crystal analysis, the intensity of reflection of X-rays must be used to evaluate the structure factor. Experiments show that intensities of reflection measured by the powdered-crystal method are accurately proportional to the square of the structure factor. The usual method of calculating the structure factor for a crystal is based upon the assumption that the atomic structure factors of the component atoms vary in the same manner with the angle of reflection.

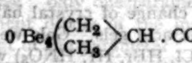
This assumption is not valid, and is particularly in error for crystals containing light elements and ions of opposite charges, as is shown by F curves obtained experimentally for the atoms in lithium fluoride, sodium fluoride, calcium fluoride and sodium chloride. For accurate determination of parameters in crystal structure, either F curves for the individual atoms should be used or some method requiring no knowledge of the F curves. Such a method consists in the use of a Fourier's series to determine the electron density at points in the unit cell of a crystal, the coefficients of the series being evaluated from the measured intensities of X-ray reflection. This method, when applied to mercurous chloride, mercurous bromide and mercurous iodide, sets the values of the parameters at $u = 0{\cdot}116$, $v = 0{\cdot}347$ in the unit cell containing two molecules of mercurous halide with mercury atoms at $00u$; $00\bar{u}$; $1/2, 1/2, 1/2 + u$; $1/2, 1/2, 1/2 - u$; and halogen atoms at $00v$; $00\bar{v}$; $1/2, 1/2, 1/2 + v$; $1/2, 1/2, 1/2 - v$. AUTHOR.

34. *Ions in Metallic Crystal Lattices.* **A. F. Scott.** (J. Phys. Chem. 30. pp. 1009–1030, Aug., 1926.)—Continued on the lines of an earlier paper [Abstract 2005 (1926)]. It is shown that certain relations exist between the nearest approach of ions in a crystal lattice, the constraint and the electronic structure. Three rules are given: (*a*) d_0 varies with $\sqrt{k}$; (*b*) k (the ionic constraint) and f (the electronic constraint) are connected by a linear relation for any iso-electronic series of atoms; (*c*) increasing nuclear charge affects f uniformly for different series of iso-electronic ions. The influence of valence electrons is considered, and is shown to lead to deviations from the first rule. Linear relations are also shown on a diagram where the atomic volumes and "electronic volumes" of the elements are plotted. A. Wh.

35. *Surface Energy of the Alkali Halides.* **J. Biemüller.** (Zeits. f. Physik, 38. 9–10. pp. 759–771, 1926.)—The effect produced by deformation of the ions upon the superficial energy of crystals of the alkali halides is investigated methematically. Satisfactory agreement is found between calculated values of the superficial energy and the capillary constants of the respective crystals, both as regards the actual values of this constant and its temperature coefficient. The various forms assumed by the "Wulff" surface are discussed, and a general solution of the problem of electrostatic surface energy is proposed on the basis of Born's theory. J. S. G. T.

36. *Tensile Tests of Large Gold, Silver and Copper Crystals.* **C. F. Elam.** (Roy. Soc., Proc. 112. pp. 289–296, Aug. 3, 1926.)—Crystals have been prepared by Bridgman's method, using a graphite tube as employed by Davey in making copper crystals. The orientations of the crystals were determined by X-rays, and diagrams are given illustrating the position of the axis of the rod relative to the principal crystal axes for the different materials, as affected by stretching. The behaviour is similar to that of aluminium, and distortion is due to slip on an octahedral (111) plane in the direction of the pole of one of the three (110) planes. A table gives the inclination of the slip planes, all of which tend to reach the same value as in aluminium. Curves are given showing the relation between the tangential component of shear stress and the extension for the different materials. The shapes of the curves for the four metals are entirely different, although the distortion is of the same type; the differences must be considered as due to the specific properties of the metals. H. N. A.

37. *Crystal Structure and Chemical Constitution of Basic Beryllium Acetate and its Homologues.* **G. T. Morgan** and **W. T. Astbury.** (Roy. Soc., Proc. 112. pp. 441–448, Sept. 1, 1926.)—The physical and chemical properties of basic beryllium acetate, $0\ Be_4(CH_3 . CO_2)_6$, are those of a non-ionised substance having the unitary structure of a typical organic compound: each chemical molecule may be regarded as a coordination complex. The tetrahedral arrangement of the eleven associated units, as confirmed by X-ray analysis, has been discussed elsewhere [see Abstract 212 (1924)]. The study of the influence of chemical constitution on the crystal structure has here been carried farther by X-ray examination of the following homologues of basic beryllium acetate:

Basic beryllium isobutyrate 
$0\ Be_4\left(\begin{matrix}CH_2\\CH_3\end{matrix}\!>CH . CO_2\right)_6$
Basic beryllium *n* butyrate $0\ Be_4(CH_3\ CH_2\ CH_2\ CO_2)_6$
Basic beryllium pivalate $0\ Be_4((CH_3)_3\ C\ CO_2)_6$

The propionate (already examined) and these are of special interest because they represent the progressive replacement of hydrogen atoms of the acetate radical by methyl groups. A brief description is given of their preparation and properties, and the results of the X-ray analyses are discussed: Basic Beryllium Acetate.—Space groups = T_h^4. The unique 0 atom lies at the centre of a regular tetrahedron of 4 Be atoms, while the six acetate groups are associated with the six edges, each group being symmetrical about a dyad axis. Basic Beryllium Pivalate.—Monoclinic domatic, probably C_s^4, with eight asymmetric molecules in a face-centred cell. Similarities with acetate are discussed. Basic Beryllic Isobutyrate.—A complete change of crystal type. Nothing can be deduced about the atomic arrangement. Basic Beryllium Normal Butyrate.—Melting point so low that the crystals quickly melt and can only be examined by the powder method. Crystals of low symmetry, and probably the molecules crystallographically asymmetric. J. E.

38. *Structure and Isomorphism of the Tervalent Metallic Acetylacetones.* **W. T. Astbury.** (Roy. Soc., Proc. 112. pp. 448–467, Sept. 1, 1926.)—Ten tervalent metallic acetylacetones have been examined by X-rays with a view to determining their crystal structures and the nature of the remarkable isotrimorphism which they collectively exhibit. Of the α (monoclinic) form were examined the acetylacetones of aluminium, chromium, manganese, cobalt and gallium; of the β (orthorhombic) form, scandium, gallium and indium; of the γ (orthorhombic) form, iron and gallium. A single crystal of gallium γ acetylacetone has been observed for the first time. By means of the spectrometer and photographic methods it has been shown that the α acetylacetones are monoclinic-prismatic, space-group C_{2h}^5; the β acetylacetones are rhombic-pyramidal, space-group C_{2v}^7; and the γ acetylacetones are rhombic-pyramidal, space-group C_{2v}^9. The α form contains four chemical molecules per unit cell, the β-form four, and the γ-form sixteen. In the γ-form the molecules appear to be associated in four groups of four chemical molecules each.

The positions of the molecules in the three forms have been determined by a study of the intensity distribution in a series of rotation photographs about various crystallographic axes. Several of the crystals have been examined for etched figures, pyroelectricity and optical activity. In spite of external appearance, none of the three forms is pseudo-hexagonal. By means of the molecule that has been deduced from chemical considerations the relation between the three forms and the nature of the isotrimorphism is explained and the main outlines of the three structures sketched. An addendum, from the chemical point of view, has been contributed by **G. T. Morgan.** AUTHOR.

39. *Change of Crystal Structure of Some Salts when Crystallised from Silicic Acid Gel. The Structure of Silicic Acid Gel.* **H. A. Fells** and **J. B. Firth.** (Roy. Soc., Proc. 112. pp. 468–474, Sept. 1, 1926.)—Describes the change of crystal habits of certain salts when crystallised out from silicic acid gels. Gels were prepared by mixing equal volumes of 3N acid (HCl, HBr, HI, HNO_3) with sodium silicate solution of density 1·15. The gel was dried *in vacuo*, and as it dried became covered with fine needles. These were examined microscopically, and their features, habits and optical properties are described. Toluidine hydrochloride and aniline hydrochloride gave similar results. In the authors' opinion the importance of the results is not so much with the new features, but with the fact that the habits are changed to a common one of fibrous structure. It is suggested that this points to (*a*) a capillary structure of the gel, and (*b*) a concentration at the capillary pores which become centres of crystal growth. J. E.

40. *The Distortion of Iron Crystals.* **G. I. Taylor** and **C. F. Elam.** (Roy. Soc., Proc. 112. pp. 337–361, Sept. 1, 1926.)—The crystals employed were prepared for the authors by Edwards and Pfeil by their new method, and were either cut into uniform bars of rectangular cross-section about 2 mm. square and distorted in tension, or into circular discs which were compressed between polished steel plates. Full details are given of the methods employed in taking these measurements and in correlating them to the X-ray measurements, the results being given in tables and in a number of stereographic diagrams. The mechanism of distortion in iron crystals is quite different to that governing the slip of the metals previously investigated. The direction of slip has a definite relation to the crystal axes, but the plane of slip is not a definite crystal plane; it appears to be related to the distribution of stress. It looks as if the particles stick together along a definite crystallographic direction, and the distortion is compared to that of a large bundle of rods which slide on one another; they stick together in groups of irregular cross-section, and the slip lines which appear on a polished surface are the traces of these small bundles on the surface. The slip lines observed on various polished faces of the distorted metal agree with the results deduced from the above theory, which is illustrated by a model built up of a number of hexagonal rods.
H. N. A.

41. *The Molecular Structure of Methane.* **V. Guillemin, Jr.** (Ann. d. Physik, 81. 2. pp. 173–204, Sept. 8, 1926.)—Whilst most of the properties of methane can be explained on the assumption of a tetrahedron structure, the observation of Cooley [Abstract 306 (1926)] of two bands with different $\Delta\nu$ in its infra-red spectrum suggests a molecule with two different moments of inertia and two rotational frequencies. In some carbon compounds, moreover, such as pentaerythritol [Mark and Weissenberg, Abstract 2367 (1923)] the lattice appears to be pyramidal, and not tetrahedral. Grimm's view on pseudo-atoms [Abstract 35 (1926)] would also make methane pyramidal. The author assumes the four H atoms of CH_4 to be at the corners of the square basis of a pyramid, the C at the apex, and the dimensions in accord with the distances between the lines of the absorption bands, and calculates the properties of this model by two methods. Firstly, the molecule is regarded as a configuration of point charges and dipoles; the polarisability of the C-ion and the potential energy deduced agree with other observations, and the nuclear vibration frequency is of the correct order. Secondly, the positive charges are again considered as point charges, but all the negative electrons supposed to form a uniform volume charge; only one parameter will enter into the calculation, and the permanent dipole of the molecule would always have the value zero independent of the parameter; the frequency would be slightly different, but the properties in general would be as in the first case. On both assumptions the pyramid would be more stable than the tetrahedron model. H. B.

42. *Structure of the CO_2 Molecule.* **D. M. Dennison.** (Zeits. f. Physik, 38. 1–2. pp. 137–140, 1926.)—Comments on a paper by Schaefer and Philipps [see Abstract 2387 (1926)]. These workers had made absorption measurements in the infra-red on carbon-dioxide, and their results supported the present author's model for the CO_2 molecule. Dennison points out that their work is partly in support, but a difficulty arises in connection with the theoretical interpretation of the absorption spectrum. In certain details the experimental results do not agree with what would be expected theoretically; this is either because of experimental details, or because the theory does not take into account the effect of rotations on the oscillations. A. C. M.

43. *Quantum Mechanics of Impact Processes.* **M. Born.** (Zeits. f. Physik, 38. 11–12. pp. 803–827, 1926.)—In this mathematical investigation it is found that the Schrödinger form of quantum mechanics permits the definition in a natural way of the frequency of a state with the aid of the intensity of the characteristic oscillation. This conception leads to a theory of impact processes by which the transition probabilities are determined by the asymptotic behaviour of aperiodic solutions. H. H. Ho.

44. *Canonical Transformations in Quantum Mechanics. Part II.* **P. Jordan.** (Zeits. f. Physik, 38. 6–7. pp. 513–517, 1926.)—This mathematical paper supplements and generalises the results of Part I [see Abstract 2020 (1926)]. New presentations of canonical transformations are given, and also an example of the convergence problem of the power series of q numbers. H. H. Ho.

45. *A Generalisation of the Quantum Conditions for the Purposes of Wave Mechanics.* **G. Wentzel.** (Zeits. f. Physik, 38. 6–7. pp. 518–529, 1926.)—The arranged Riccati differential equation of the Schrödinger wave equation [see Abstract 2017 (1926)] is found to be integrable by a

series of rising powers of h in such a way that the zero approximation corresponds to classical mechanics, *i.e.*, to the earlier quantum theory, while the addition of the higher powers of h permits a progressive approximation to the new quantum or wave mechanics to be attained. The Sommerfeld quantum conditions $\oint y dx = k \,.\, h$ remain valid when the solution of the Riccati differential equation is put for y (instead of the impulse p). The solution of the special problem thus given is found to be mathematically identical with that of the author's result in the matrix mechanics. Application to the hydrogen atom affords a very simple derivation of the Balmer series formula. The calculation of the Stark effect confirms the known formula for the linear effect, while on the other hand Epstein's formula has to be modified for the effect of the second order. For Hγ this difference in the middle component is theoretically 19 % and experimentally about 20 %. For the fundamental state the quadratic effect is 4·5 times as great as that of Epstein, a result of interest for a future theory of the helium arc spectrum.
H. H. Ho.

46. *Molecular Fields of Hydrogen, Nitrogen and Neon.* **J. E. Lennard-Jones** and **W. R. Cook.** (Roy. Soc., Proc. 112. pp. 214–229, Aug. 3, 1926.)—Refers to recent papers on molecular fields [see Abstracts 452 and 917 (1926)] and makes use of the isotherms of H, N and Ne just published by Holborn and Otto to check the results. The force constants of neon determined from the isotherms by means of the authors' theory are almost identical with those calculated from its viscosity and thermal conductivity. Although the theory of the equation of state is applicable only to fields which are spherically symmetrical, it has been applied to H and N; the divergence between theory and experiment is very slight indeed, and in the case of H no difference could be detected; the value of the force constant is in remarkable agreement with that found by the other method. This had previously been found to be true for He. The discrepancy for N is about the same as that previously found for Ar; reasons are given for supposing that for these two gases the results from the equation of state are the more reliable. The paper contains numerous tables giving the results obtained, with illustrative graphs which show the close agreement between the theoretical curves and Holborn and Otto's experimental results. H. N. A.

47. *The Planck Distribution Law and the Quantum Hypothesis.* **R. G. Loyarte.** (Univ. Nac. La Plata, Estudio Ciencias, Serie Mat.-Fis. 71. pp. 491–494, March, 1926.)—Planck's distribution law can be deduced from the known statistical formula for free energy

$$F = k\mathrm{NT} \log \Sigma e^{-\epsilon_n/k\mathrm{T}},$$

where N represents the number of small elementary cellules of extension h^3 which re-enter in the interval $\delta\nu$, and $\epsilon_n = nh\nu$, $n = 1, 2, 3 \ldots \infty$. The present deduction is formally different from that of Bose; the number of quanta distributed in the different elementary domains, at a given temperature, is obtained from the law of distribution of energy by dividing by $h\nu$. A. D.

48. *Heat of Dissociation of Non-Polar Molecules.* **R. T. Birge** and **H. Sponer.** (Phys. Rev. 28. pp. 259–283, Aug., 1926.)—The limiting vibrational energy of a diatomic molecule is given by $E_n = h\int_0^{n_0}\omega'' dn$. Since the ω'' : n curve is linear, E_n can be evaluated from band spectra data. E_n also represents the heat of dissociation, but may also include the excitation energy of an excited atom produced. The band spectra of O_2, O_2^+, N_2, N_2^+, CO, CO^+ and NO are treated in some detail. A. Wh.

49. *Isotopic Effect in Infra-Red Absorption Spectra.* **E. K. Pyler.** (Phys. Rev. 28. pp. 284–290, Aug., 1926.)—The infra-red absorption spectrum of brucite shows maxima corresponding to Mg^{24}, Mg^{25}, Mg^{26} and a band possibly due to Mg^{28}. Coblentz's data also show evidence of isotopic effects in the case of nickel sulphate, Ni^{58} and Ni^{59} being observed. With potassium sulphate two isotopes are also indicated. The solid sulphates of barium, strontium and magnesium show complex maxima, but as the light was unpolarised these may be due to pleochroism. Work is proceeding on these substances using definite orientations. A. Wh.

50. *Atomic States and Spectral Terms.* **J. C. McLennan, A. B. McLay** and **H. G. Smith.** (Roy. Soc., Proc. 112. pp. 76–94, Aug. 3, 1926.)—A paper indicating the method of application of the Heisenberg-Hund theory to the analysis of spectra of certain elements of which details will be given in later papers. A table of results for all the elements is given and detailed notes of the methods used to obtain them. The paper should be consulted. A. Wh.

51. *Dynamical Model for Complex Atoms.* **J. C. Slater.** (Phys. Rev. 28. pp. 291–317, Aug., 1926.)—Following out the ideas of Hund and others on complex spectra, and of Goudsmit and Uhlenbeck on the spinning elctron, a model for a complex atom is set up, consisting of electrons whose intrinsic and orbital angular momentum vectors act on each other with torques whose energies are proportional to the cosines of the angles between. The dynamical equations of this model are solved and the quantum conditions are applied. These agree with the quantum conditions previously set up empirically, as far as those go, but also yield new quantum numbers relating to the orientation of electrons. The formula for the energy in terms of the quantum numbers is set up. This is not only in qualitative agreement with what has been previously found, but it furnishes an explanation of inverted multiplets, of the fact that relativity doublets follow the same formula as alkali doublets but are inverted, and of the fact that doublets and triplets both fit on the same "relativity" doublet curve. AUTHOR.

52. *Rotation of Molecules.* **D. M. Dennison.** (Phys. Rev. 28. pp. 318–333, Aug., 1926.)—On the basis of the new quantum mechanics the rotational motion of the following molecules has been treated from the point of view of systems involving restraints: (1) the simple rotator in a plane; (2) the simple rotator in space; and (3) molecules having an axis of symmetry. The quantum mechanical treatment of systems having restraints has been discussed and certain quantum conditions governing them have been obtained. The simple rotator in a plane is found to have an energy $W = (m^2 + m + \frac{1}{4})h^2/8\pi^2 Ma^2$ and a total angular momentum $\mu = (m + \frac{1}{2})h/2\pi$. The quantum number m may be whole or half numbered, the corresponding normal states being $m = 0$ and $m = -\frac{1}{2}$. The simple rotator in space has an energy $W = (m^2 + m + 1)h^2/8\pi^2 Ma^2$ and the square of its total angular momentum is $\mu^2 = m(m + 1)/h^2/4\pi^2$. The number m must be integral and the normal state is $m = 0$. Molecules having moments of inertia $A = B$ and C are found to have an energy

$$W = \left\{\left(\frac{1}{A}\right)(m^2 + m + 1) + \left(\frac{1}{C} - \frac{1}{A}\right)n^2 + \frac{1}{2C} - \frac{C}{4}\left(\frac{1}{C} - \frac{1}{A}\right)^2\right\}\frac{h^2}{8\pi^2}$$

and the square of their total angular momentum is again $\mu = m(m + 1)h^2/4\pi^2$. The numbers m and n must be either both integral with normal state $m = n = 0$, or both half-integral with normal state $m = \frac{1}{2}$, $n = \pm\frac{1}{2}$. The differences between these two solutions which may be expected to appear in the observed infra-red spectra are discussed. For all three examples the quantum theoretical amplitudes giving the transition probabilities have been obtained. AUTHOR.

53. *Application of Pauli's Method of Coordination to Atoms having Four Magnetic Parts.* **G. Breit.** (Phys. Rev. 28. pp. 334–340, Aug., 1926.)—It is shown that the origin of spectral terms of an arc spectrum obtained by adding a highly excited electron to a certain term of the spark may be understood in terms of an application of the principle of mechanical transformability made by Pauli. According to this application it is sufficient to know (*a*) the strong and weak field magnetic quantum numbers of a level, (*b*) which of the two vectors r or h is the faster in a magnetic field, (*c*) whether the term is inverted or not in order to tell the value of j belonging to that level. The derivation of Pauli's results is based on sufficiently general principles to enable one to apply it to the Pauli-Hund method of tracing spectral terms. The possible groupings of the j_a's or the j_s's are discussed, and it is shown that Pauli's principle is valid here also. AUTHOR.

54. *Intensity of the Band Lines and of the Affinity Spectrum of Diatomic Molecules.* **E. Fues.** (Ann. d. Physik, 81. 3. pp. 281–313, Sept. 17, 1926.)—Reasons are advanced for assuming that the Heisenberg matrix elements q^{ij} corresponding to a coordinate q are related to the eigenfunctions of the Schrödinger wave equation by equations of the form $q^{ij} = \int q u_i u_j d\tau$, where u_i and u_j are eigenfunctions corresponding to the discrete spectrum and the integral is extended over the complete coordinate space, q being a proportionality factor. In the present paper the evaluation of the matrix elements is undertaken for the case of the diatomic molecule using the solution of the wave equation given in a previous paper [see Abstract 2259 (1926)]. Similar methods are then discussed for arriving at the intensity factors of the "affinity spectrum," *i.e.* the continuous spectrum corresponding to jumps form hyperbolic orbits in the dissociated state to the elliptic orbits of the combined atoms. The paper is entirely mathematical. W. S. S.

55. *Quantisation as a Problem of Characteristic Values. Part IV.* **E. Schrödinger.** (Ann. d. Physik, 81. 2. pp. 109–139, Sept. 8, 1926.)—In the previous communications [see Abstracts 2017 and 2537 (1926)] the wave equation $\nabla^2\psi - \frac{2(E - V)}{E^2}\frac{\partial^2\psi}{\partial t^2} = 0$ for the field scalar

ψ is used to solve problems in quantum mechanics where the potential energy V is a function of the coordinates alone and does not contain the time explicitly. In the present paper the modifications necessary when V is allowed to involve the time explicitly are considered. The complex field scalar is now called upon to satisfy one of the equations $\nabla^2\psi - \frac{8\pi^2}{h^2}V\psi \mp \frac{4\pi i}{h}\frac{\partial\psi}{\partial t} = 0$. If V does not contain the time explicitly these equations are equivalent to the one first quoted. The new equation is now applied to the problem of the perturbations of a conservative system arising from a perturbing potential energy function which varies periodically with the time, *i.e.* to the problem of dispersion. The resulting formulæ show that the secondary radiation will contain the combination frequencies just as the Born-Heisenberg-Jordan mechanics indicate, but the present deduction gives information as to the specific conditions which correspond to the radiation of these frequencies. The mathematical theory is unable to deal with the actual resonance case, as the assumption of small perturbation breaks down here. A formulation of the new wave equation for a single electron taking into account a magnetic field and relativistic change of mass with velocity, is outlined tentatively. In a final section the physical of the field scalar ψ is discussed. W. S. S.

56. *Effective Cross-Section of Gas Molecules towards Slow Electrons.* **M. Rusch.** (Ann. d. Physik, 80. 7. pp. 707–727, July 29, 1926.)—A new method for determining the effective cross-section of gas particles towards slow electrons is described. The method differs from that employed by Ramsauer [Abstract 216 (1924)] in that a longitudinal magnetic field is used. Measurements for argon in the region 3·5 to 29 volts made by the new method are in close agreement with Ramsauer's results. A. W.

57. *Transformations Associated with the Lorentz Group and their Invariants.* **C. Baraff.** (Washington Acad. Sci., J. 16. pp. 377–387, Aug. 19, 1926.)—It is the aim of this paper, in continuation of the results presented in a former paper [Abstract 1258 (1926)], to elucidate some of the quantities and expressions that remain invariant to a special relativity transformation. The results are set down in a mathematical form with little or no comment. Their physical interpretation is reserved for a future paper. Most of the transformations are taken from Einstein's original paper of 1905 on the special relativity theory. The invariants are derived by the methods outlined in Wright's Invariants of Quadratic Differential Forms. The invariants derived constitute a set of independent invariants from which other dependent invariants may be derived by the ordinary processes of algebra and calculus. G. W. DE T.

58. *Repetition of the Trouton-Noble Ether Drift Experiment.* **C. T. Chase.** (Phys. Rev. 28. pp. 378–383, Aug., 1926.)—Experimental reasons are given showing that previous failures of this experiment to detect motion of the earth in the ether have not been conclusive. In particular the author considers that Tomaschek's negative results are invalidated by frictional forces exerted on the fine wire dipping into sulphuric acid and used to charge the condenser, and by the inadequacy of the means employed to maintain the potential of the condenser

constant. The experiment has therefore been repeated with an apparatus free from these possible sources of error and sufficiently sensitive to detect a motion in the ether of 4 km./sec. No such motion was found.
J. S. G. T.

59. *Relativity and Miller's Repetition of the Michelson-Morley Experiment.* **L. Page** and **C. M. Sparrow.** (Phys. Rev. 28. pp. 384–391, Aug., 1926.)—It is shown that Miller's results [see Abstract 2025 (1926)] can be brought into accord with the relativity principle by assuming that space is anisotropic to the extent that the velocity of light travelling normal to the ecliptic is 16·7 cm./sec. less than that of light travelling in the plane of the ecliptic. Possible causes of this anisotropy are discussed. Space-time transformations are deduced for such an anisotropic space.
AUTHORS.

60. *The Michelson Experiment Carried Out in a Free Balloon.* **A. Piccard** and **E. Stahel.** (Comptes Rendus, 183. pp. 420–421, Aug. 17, 1926.)—Repetitions of the Michelson experiment carried out in a balloon at heights of 2500 and 4500 metres neither confirmed nor refuted Miller's results relating to ether drift, but indicated that if the ether drift postulated by Miller exists, its magnitude does not increase with altitude.
J. S. G T.

61. *Velocity Greater than that of Light on the Theory of Relativity.* **L. Strum.** (Phys. Zeits. 27. pp. 541–544, Aug. 15, 1926.)—Polemic with Bass [Abstract 1257 (1926)], particular attention being paid to the apparent violation of the relation of cause and effect, *viz.*, that cause must precede effect, suggested by Thirring's problem of the propagation of a light signal in opposite directions between two systems in relative motion.
J. S. G. T.

62. *The Spatially-Extended Electron in the General Theory of Relativity.* **V. Fréedericksz** and **A. Isakson.** (Zeits. f. Physik, 38. 9–10. pp. 788–802, 1926.)—The question of the possibility of the continuous existence of the spatially-extended electron, discussed by Einstein [see Abstract 837 (1919)] is treated from the standpoint of the postulation of a field comprising an energy tensor and a material tensor, the latter of which is entirely unrestricted in character. An investigation of the case treated by Einstein indicates that the material energy of the single electron (as distinct from its gravitational energy, using the terminology introduced by Klein) is one-quarter of its mass energy. This result identifies Einstein's energy of the gravitational field with the material energy. The synthesis of the spatially-extended electron does not necessitate the assumption that the scalar curvature of empty space is different from zero.
J. S. G. T.

63. *The Equations of Motion in Accordance with the Principle of Relativity.* **H. Mandel.** (Zeits. f. Physik, 39. 1. pp. 40–53, 1926.)—The author investigates what form of the equations of motion, conforming with the principle of relativity, represents the most natural generalisation of the classical equations of motion. The necessary equations are deduced in terms of the four-dimensional vector associated with a specific impulse, whose direction is always that of the four-dimensional velocity; the associated factor of proportionality is equal to the energy density of the system at rest. J. S. G. T.

64. *Derivation of the Field Equations of the General Theory of Relativity.* **H. Mandel.** (Zeits. f. Physik, 39. 2 and 3. pp. 136–145, 1926.)—Non-Euclidean measurements in four-dimensional space-time are interpreted in terms of the geometry of a universe comprising a four-dimensional hypersurface in a higher(4 + K dimensional) Euclidean space, in much the same way as one interprets non-Euclidean measurements on a two-dimensional surface by reference to the characteristics of a three-dimensional Euclidean space. The matter-energy tensor is found to be closely related to the second fundamental tensor of this hypersurface. Geodesics are lines of curvature of the universe, and it is suggested that the discussion of a five-dimensional universe is essential to the interpretation of the electromagnetic properties of matter.

J. S. G. T.

METEOROLOGY AND GEO-PHYSICS.

65. *The Comparison of Sunshine Recorders of the Campbell-Stokes Type.* (Meteorolog. Office, Prof. Notes No. 45. [14 pp.], 1926.)—A report prepared in the Meteorological Office, London, at the request of the International Meteorological Committee.

66. *Investigation of Cycles and Relation of the Brückner and Solar Cycle.* **A. Streiff.** (Monthly Weather Rev. 54. pp. 289–296, July, 1926.)—Reference is made to the large number of periods found by other authors when investigating records of rainfall, temperature and sunspot cycles. Some of these periods have been shown to be variable and the amplitude also. From general considerations a hypothetical expression is obtained which, though lacking absolute proof, yet appears probable. A method of strato-analysis is then employed to find the separate elements, and these results can also be obtained by a graphical method. These methods are applied to obtain a relation between the solar cycle and certain terrestrial phenomena. A study of the level of the Great Salt Lake reveals an eleven-year cycle, but with a change in phase of about 180°. Rainfall exhibits a similar correlation with sunspots and tree growth also, while the change in phase varies with the locality. To illustrate the relation of short solar cycles with rainfall, a comparison is made with the periodic variations in river flow. Fortuitous variations in rainfall over a large drainage area are thus eliminated. It is thus shown that precipitation is related with the Wolf numbers as well as with the larger variations, and the Wolf chart may therefore be expected to be the extension of the Brückner cycle. R. S. R.

67. *Variations in Atmospheric Visibility.* **G. Guilbert.** (Comptes Rendus, 183. pp. 427–429, Aug. 17, 1926.)—It is found that the variations in visibility are independent of the humidity, insolation, temperature, and type or amount of cloud. The phenomenon remains inexplicable.

A. W. L.

68. *Intensity and Polarisation of Sky Light at Sunrise and Sunset.* **K. R. Ramanathan.** (Nature, 118. pp. 337–338, Sept. 4, 1926.)—As the illumination of the clear day-sky at high-level stations is almost entirely due to molecular scattering by the atmosphere, the author made calculations of the intensity of the illumination for a place 2 km. above sea-level with the sun on the horizon for the wave-lengths $0 \cdot 45\,\mu$, $0 \cdot 55\,\mu$ and $0 \cdot 65\,\mu$. The ratio of blue to red is for all zenithal distances less than that given by the fourth power law. The calculated values are of the same order of magnitude as those observed by Dorno at Davos, but the observed values tend to be greater in the quadrant of the sky containing the sun. The contributions to the total illumination of different layers for the red and blue are tabulated, primary scattering only being considered, but it is shown that self-illumination cannot be quite neglected. R. S. R.

69. *Results of Measurements on the Polarisation of Sky Light in Different Spectral Regions.* **J. J. Tichanowsky.** (Meteorolog. Zeits. 43. pp. 288–292, Aug., 1926.)—Measurements of the degree of polarisation were made at twelve different places with heights ranging from sea-level to 1180 m. above, by means of a Marten's polarisation photometer. Three filters were used to test a range of wave-lengths, red (759–599), green (562–495), and blue (475–396 $\mu\mu$). In a table the results are set out for the maximum polarisation in the three spectral regions with the sun at heights ranging from 0° to 65°. It was found that (1) for the purest condition of the atmosphere, for any solar height the maximum polarisation occurs in the red and the minimum in the blue; (2) with decrease of purity, and also decrease of polarisation, the maximum is displaced to the green and then to the blue region; (3) with further decrease of purity, and especially increase in the amount of condensed water vapour, the maximum is again in the red. The polarisation in the zenith for different solar heights and that at distances of 30° to 150° from the sun for solar heights of 0° to 30° is also tabulated. The degree of polychroism, caused by different degrees of polarisation for the several colours, is greatest for clear weather. With decrease of polarisation the positive polychroism falls to zero and becomes negative, corresponding to increased impurities in the atmosphere. With the purest atmosphere the dispersion and polychroism are predominantly caused by secondary diffusion, and with a sufficiently impure atmosphere they are caused principally by the large foreign particles which are present. [See also Abstract 544 (1925).] R. S. R.

70. *Atmospheric Transparency in the Visible Spectrum, Molecular Diffusion, and Ozone Absorption.* **J. Cabannes** and **J. Dufay.** (J. de Physique et le Radium, 7. pp. 257–274, Sept., 1926.)—The absorption coefficient (k) for a pure gas is expressed in the form $k = \frac{8\pi^3}{3\lambda^4} \cdot \frac{(\mu^2 - 1)^2}{n} \cdot \frac{6 + 3\rho}{6 - 7\rho}$, where λ is the wave-length, μ the refractive index, n molecular density, and ρ depolarisation. The optical density of the atmosphere above Mount Wilson has been computed for various wave-lengths on the assumption that the atmosphere is a mixture of perfect gases, and the values are compared with Fowle's measurements. There is close agreement from the blue to ultra-violet, indicating that molecular diffusion is the predominating process for that region. Deviations in the region 4800 to 6500 Å. show selective absorption which is attributed to an amount of ozone in the upper strata equivalent to a layer about 0·3 cm. thick under normal pressure. An examination of several series of absorption data, chiefly by Fowle, confirms this conclusion, the mean thicknesses of ozone varying from 0·27 cm. to 0·4 cm.; the mean values indicate maximum ozone coinciding with minimum solar activity in 1913. A. W. L.

71. *Importance of Water Vapour in the Atmosphere.* **J. Patterson.** (Roy. Astron. Soc. Canada, J. 20. pp. 201–209, July–Aug., 1926.)—A *résumé* of the properties of water vapour and its effects upon atmospheric conditions. The following subjects are discussed: Evaporation and supersaturation; humidity; condensation and formation of fog; fall of raindrops; upward currents and the formation of hailstones; humidity forecasts as a basis for estimating the risk of forest fires. A. W. L.

72. *Solution of Problems of Atmospheric Motion by Means of Model Experiments.* **C. G. Rossby.** (Monthly Weather Rev. 54. pp. 237–240, June, 1926.)—The method of dynamic similarity which has been used to study the circulation and pressure distribution round aeroplane models in wind tunnels has been followed for problems of atmospheric motion. The general dynamical equations for this type of motion are developed and suitable modifications introduced to meet conditions which exist in the atmosphere. A model vessel is then examined which can rotate about a vertical axis and its base covered with liquid paraffin wax. This liquid on rotation will acquire the paraboloid shape which holds for the earth's surface. If motion of the air over a specified area and to a certain height is required, the requisite length, height and time scales are calculated, the vessel filled to the necessary depth with liquid and observations made of the liquid when the vessel is rotated. R. S. R.

73. *Dependence of the Length of a Column of Condensed Steam.* **W. Schmidt.** (Meteorolog. Zeits. 43. pp. 292–294, Aug., 1926.)—Expressions are obtained for (1) the concentration of the vapour in terms of the density and pressure of the air, velocity of travel through the air and distance from the path; and (2) heat of condensation of the vapour. Combining these, it is found that the length of the column of condensed vapour is proportional directly to the amount of vapour introduced and inversely to the saturation deficit and turbulence in the atmosphere, while independent of the rate of travel through the air. Numerical examples are taken to illustrate these relations. In windy weather the column is shortened by the increased turbulence. This effect may be used as an indication of the approximate degree of turbulence in the air. R. S. R.

74. *Observing Water-Surface Temperatures at Sea.* **C. F. Brooks and F. G. Tingley.** (Monthly Weather Rev. 54. pp. 241–254, June, 1926.)—The paper is largely a summary of water-surface temperature comparisons obtained during a cruise between New York and the West Indies. An attempt was made to determine the accuracy of observational methods under a great variety of conditions. Temperatures obtained almost simultaneously from various parts of the ship showed that surface observations may most readily be made in cold windy weather from the stern, but a record from the condenser intake pipe appears truly representative of the surface temperatures under virtually all conditions. Measurements with a canvas bucket give low results as a consequence of cooling by evaporation as the bucket is lifted, pre-dip temperature of the bucket, and other small avoidable errors. In the Gulf Stream region errors of 5° F. were found, while in cold gales over the Gulf Stream the average error was still larger. An analysis of some observations made on the ice patrol ships shows the same tendencies when the air was much colder than the sea. It was found that the errors were closely related to the depression of the wet bulb or air temperature below the water temperature. It was shown that with due care and using dry stiffened canvas or wooden or fibre buckets dropped from a lower deck, heaved up rapidly and as quickly observed, accurate temperatures were obtainable. The use of a thermograph, the thermal element of which projects into the condenser intake pipe, is recommended, however, as much the easiest method for procuring temperatures of the general surface layer accurately under all conditions of weather. R. S. R.

75. *Fireballs of Nov. 15 and Dec. 29, 1925.* **W. J. Fisher.** (Roy. Astron. Soc. Canada, J. 20. pp. 225–251, Sept., 1926.)—Observations of (1) a fireball on Nov. 15, and (2) several meteors on Dec. 29, 1925, from a large number of places in New England and Canada were investigated to find the location, probable path and time of passage of these phenomena. In one case a computation of the heliocentric velocity and orbit could be made, while the changes in the form gave some information regarding air currents at a height exceeding forty miles.

R. S. R.

ASTRO-PHYSICS.

76. *Method for Verifying the Constancy of the Sidereal Day.* **G. Bigourdan.** (Comptes Rendus, 183. pp. 437–440, Aug. 23, 1926.)—The author suggests that though the mean value of the sidereal day has not varied as much as $0^s \cdot 01$ since Hipparchus, it may be momentarily disturbed and within narrow limits, and proposes a test by means of a great vertical right-angled triangle, SOA. S is at the top of a mountain, and consists of a series of round metallic stems, which from the distance of the observer at O in a valley due north of S (for the northern hemisphere) appear like fine micrometer threads, across which the successive transits of an equatorial star are noted for the intervals t_1, t_2, t_3, etc. (close to 24 hours sidereal). If these well-determined intervals from different stars are always found to be the same to the greatest precision, then the conclusion could be drawn that the relative positions of S and O are invariable, that the time-keepers are regular, and that the length of the sidereal day is constant. If they are not always found to be the same, by multiplying the observations it should be possible to distinguish between these three possible sources of the inequality and to evaluate the amounts of each. A. S. D. M.

77. *Precision of Hour of B.I.H. Rhythmic Signals.* **N. Stoyko.** (Comptes Rendus, 183. pp. 444–446, Aug. 23, 1926.)—The actual rhythmic signals are made up of 306 equidistant signals emitted in 300^s of mean time. At B.I.H. (Bureau International de l'Heure) the emission is governed by a little pendulum for half-seconds synchronised by a mean time pendulum (1116 Leroy). In order that the rhythmic signals should go out at the appointed hour, the pendulum 1116 Leroy is given a correction *c*, extrapolated for that hour and determined empirically; this varied from $0^{s}\cdot 04$ to $0^{s}\cdot 06$ in the first quarter of 1926. The author finds that out of 314 emissions of the rhythmic signals there were 32 emissions for which there was an error greater than $0^{s}\cdot 02$ with respect to the appointed hour (C), and 9 where it was greater than $0^{s}\cdot 03$. He urges that it is useless to make a provisional correction of the order of $0^{s}\cdot 02$ sent out on the morrow radiotelegraphically (as is done at present) when there remains an error at least four times as great, which is corrected only after a period of four to six months. A. S. D. M.

78. *Regularity of Diurnal Motion and Possibility of Checking it by Means of Pendulums.* **G. Bigourdan.** (Comptes Rendus, 183. pp. 461–463, Aug. 30, 1926.)—Even when the errors of reception are included with the perturbations of transmission of the rhythmic radiotelegraphic signals, they do not exceed $0^{s}\cdot 01$. If, instead of comparing the corrected (or *absolute*) hours, the uncorrected hours are compared, it is found that the uncorrected indications of the different timekeepers corresponding to the *same* signals are almost as exact as if these timekeepers were together at the same observatory. The comparison of the numbers thus obtained might serve to verify the constancy of the sidereal day. The author shows how this could be done without undue labour or expense through the fifty observatories taking part in the scheme of interterrestrial longitudes of October 1 to November 30, 1926. A. S. D. M.

79. *On Convergence of Series in Mécanique Céleste.* **K. Popoff.** (Comptes Rendus, 183. pp. 472–474, Aug. 30, 1926.)—The author considers the work of Poincaré in the Academy of Science for Feb., 1882, on the integrals of a system of differential equations, and that of Sundman, in *Acta Mathematica*, 1912–13, on the problem of three bodies. Here the problem was developed by increments of a variable function of the time, valid for all real values of *t*. But in the *Mécanique Céleste* certain parameters, such as eccentricity and mass, are developed, and the author applies these developments from Poincaré's point of view, taking as examples the series of elliptic motion in powers of the eccentricity and the problem of three bodies in powers of the mass. A. S. D. M.

80. *Solar System: Some Unsolved Problems.* **R. G. Aitken.** (Science, 64. pp. 191–198, Aug. 27, 1926. Paper read before the Am. Assoc. for the Advancement of Science, June, 1926.)—(1) Unexplained anomalies in the motion of the moon (*e.g.*, the empirical term with a period of 270 years and other shorter periods which are not accounted for by known gravitational forces), or of planets, of which the advance of the perihelion of Mercury alone is explained by the relativity theory. (Newcomb and, later, Brown and Innes have suggested that these may be due to actual changes in the earth's rotation, perhaps to variations in its external radius of from 5 in. to 12 ft.). (2) Changes near certain lunar craters; the origin of lunar markings; crateriform or rays; the moon's shape, spherical or ovoid. (3) Temperature and constitution of the Martian atmosphere; the nature and origin of the Martian markings and canals. (4) Physical condition of Jupiter and Saturn; whether they are semi-suns or very cold, and, in the latter case, the nature of their belts and spots; the interpretation of the broad absorption bands in the red end of their spectrum. (5) Why Saturn alone has a ring system. (6) The relation of the minor planets to the other members of the solar system, and if they may be captured by Jupiter or Saturn. (7) Especially their relationship to comets, and of these to the solar system. (8) Lastly, the problems of the sun itself; its duration; its radiation; the mechanism of the release of its energy; its place in the giant-dwarf evolution; its corona; and the cause of its sunspot cycle. A. S. D. M.

81. *Solar Radiation and Weather Forecasting.* **C. F. Marvin** and **H. H. Kimball.** (Frank. Inst., J. 202. pp. 273–306, Sept., 1926.)—Details are given of the construction of various types of pyrheliometers and of the methods employed in reducing the observed values of solar radiation to zero air mass. It is concluded from an examination of available solar constant values that such solar variability as exists is submerged in the errors of determination [see also Abstracts 255 and 256 (1926)]. The forecasts of temperature for New York by Clayton [see Abstract 1771 (1926)] were not based solely upon values of the solar constant, but were aided by considerable experience of weather maps and a knowledge of current conditions. It is not yet established that forecasts made with the aid of solar constant values are more accurate than those made without such data. It appears likely that the variations in atmospheric absorption, particularly in the ultra-violet, are far more important in forecasting than the minute fluctuations in solar output. A. W. L.

82. *The Nature of the Visible Solar Surface.* **V. Ambarzumian** and **N. Kosirev.** (Zeits. f. Physik, 39. 1. pp. 54–68, 1926.)—The visible solar surface is conceived as constituted of a number of "maximum-radiating" layers corresponding to the different wave-lengths characterising the solar spectrum. These layers are distributed at various solar heights, and are neither accurately spherical nor similar. The respective forms and heights are variable. J. S. G. T.

83. *Physical Nature of the Solar Corona. Part V.* **W. Anderson.** (Zeits. f. Physik, 38. 6–7. pp. 530–548, 1926.)—Under certain conditions ordinary gases can exhibit extended continuous spectra, but it is found that this is not possible under the conditions which operate in the corona. If the corona should consist of ordinary gases, then an extended continuous spectrum can only be explained by the Rayleigh theory of light scattering. Even in the latter case, however, the spectral brightness distribution does not agree with the observed data; also the gravitation force can neither be compensated by radiation pressure nor by an electronic bombardment. Should the latter be achieved by a bombardment of corpuscular rays, then very much more energy must be given to the corona than it radiates. The Emden hypothesis that the corona molecules rotate around the sun like planets is shown to be untenable. In the case of the Rayleigh light scattering hypothesis, there is nothing which could be appreciably influenced by gravity, while the decline of density and brightness must be so enormous that the corona would be invisible at a very small distance from the sun's circumference. The conclusion is therefore drawn that it is impossible for the corona to consist of ordinary gases such as hydrogen. This affords indirect evidence in favour of the electronic gas theory. H. H. Ho.

LIGHT.

84. *Computation of Colorimetric Purity. Part II.* **I. G. Priest.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 123–132, Aug., 1926.)—Gives the application to the computation of the purity of non-spectral colours of the formula derived in a previous paper. [See Abstract 316 (1925) and next Abstract.] W. H. Gr.

85. *Computation of Colorimetric Purity.* **D. B. Judd.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 133–154, Aug., 1926.)—Discusses the formulæ of Ives and of Priest expressing colorimetric purity in terms of given trilinear coordinates and gives (1) the derivation of still another form of purity formula; (2) a discussion of accurate and speedy computational methods, together with an analysis for the convenience of the routine calculation of the various formulæ; (3) the extension of the new formulæ to purity for purples; and (4) a general solution for the trilinear coordinates of a colour of given purity in terms of the coordinates of the spectrum and the luminosity coefficients. [See preceding Abstract.] W. H. Gr.

86. *Colour of Luminous Sulphides of the Earth Alkali Metals.* **J. Stalony-Dobrzánski.** (Zeits. f. Physik, 38. 11–12. pp. 841–847, 1926.)—When the sulphides of the earth alkali metals which are self-luminous and colourless are powdered in a mortar, they develop a distinct colour. The colour is stronger, if instead of rubbing in a mortar it is subjected to pressure. Small plates of the sulphides which were made by strongly compressing the powder were prepared, and the colour observed and compared with the spectrum of the flame given by the metal. It was found that the colour of the earth alkali metal sulphides when strongly compressed was the same as the colour of the flame spectrum of that metal. A tentative theory for the phenomenon is given. F. J. B.

87. *Absorption of Light on Optically Non-Homogeneous Media.* **G. I. Pokrowski.** (Zeits. f. Physik, 38. 11–12. pp. 848–852, 1926.)—The paper is supplementary to earlier papers. [See Abstracts 1612 (1925) and 2066 (1926).] The relationship between the various constants of the formulæ is developed and a value for the dimensions of the light scattering and absorbing particles is obtained. F. J. B.

88. *Present Problems in Colour-Vision: Laws of Visual Fatigue and of Resultant Sensation.* **W. Peddie.** (Roy. Soc. Edinburgh, Proc. 46. 3. pp. 245–263, 1925–1926.)—The applicability of Fechner's law in its modified or unmodified form is examined and developed to give a unit of sensation. It is shown that the experimental curves of fractional threshold insensitivity correspond very closely with rectangular hyperbolæ over a large range of intensity, the insensitivity becoming less as the intensity increases. The curves of threshold value of the stimulus in terms of the external stimulus are also of this shape. Thus the law of fatigue can be given in the form : the sensation value is a linear function of the external stimulus within the given range of intensity. It is further shown for the compounding of sensations that the resultant sensation value is the sum of the component sensation values where the sensation value of a stimulus is its numerical value in terms of the threshold value as a unit, and the sensation is proportional to the logarithm of the sensation value. The use of a generalised form of the expression for the component sensation values, directly linear in the components of the observed stimulus and inversely linear in those of the fatiguing stimulus, enables an account to be given of phenomena involving cross-connection of effects. The additional inclusion of non-linear terms allows of an explanation of the peculiar and important effects of strong fatigue with results in agreement with those of F. Allen. R. S. R.

89. *Form and Brilliance of Brilliants.* **A. Johnsen.** (Preuss. Akad. Wiss. Berlin, Ber. 23. pp. 322–330, 1926.)—Discusses the influence of absorption, refraction, dispersion and angle between facets on the lustre of the diamond. W. H. Ge.

90. *Change of Refractive Index of Linseed Oil in Drying.* **A. P. Laurie.** (Roy. Soc., Proc. 112. pp. 176–181, Aug. 3, 1926.)—This paper refers more particularly to the deterioration of oil paintings. The yellowing of the oil when drying affects the appearance of pigments at the blue end of the spectrum more than those at the red end. Further, experiment has shown that the refractive index of linseed oil increases during drying (which may take many years), such increase causing a degradation of the apparent pigment colours. M. G. S.

91. *Transmissions of the Oldenberg Chlorine Filter for λ2537.* **D. S. Villars.** (Am. Chem. Soc., J. 48. pp. 1874–1876, July, 1926.)—The Oldenberg chlorine filter [see Abstract 540 (1925)] is more readily made than the Peskov filter, but the latter is more nearly monochromatic. B. W. C.

92. *New Ultra-Violet Transmitting Glass.* **H. P. Hood.** (Science, 64. pp. 281–282, Sept. 17, 1926.)—As no glasses other than quartz showing a high transmission in the region 290 $\mu\mu$ are commercially available, a new glass has been developed, transmitting to 200 $\mu\mu$ in 3 mm. thicknesses. Its transmission for 290 $\mu\mu$, the extreme limit of the sun's rays through the atmosphere, is 86 % for a 2 mm. thickness. Spectrograms are reproduced to illustrate the transparency in comparison with other glasses. The glass can also be prepared in various colours to produce unusual spectral filters. The new glass has a density of 2·64, a refractive index for the D line of 1·539, a dispersion of 0·009 for $N_f - N_c$, a linear expansion coefficient of nearly 0·00001, and possesses a stability within the range of ordinary glasses, while the cost of production is somewhat above that of window glass, but far below that of quartz. R. S. R.

93. *Limit of Resolution in Spectroscopic Apparatus.* **V. Ronchi.** (Accad. Lincei, Atti, 3. pp. 680–685, June 3, 1926.)—If instead of the slit of a spectroscope we substitute a suitable network, the limit of resolution is reduced to one-half. In the usual case we examine dispersion-images ; with the substitution we examine interference-images. A. D.

94. *Metallic Replicas of Diffraction Gratings.* **Z. A. Merfield.** (Roy. Soc. Victoria, Proc. 38. pp. 62–64, 1926.)—Methods already employed to obtain metallic grating replicas are summarised together with the difficulties encountered in their use. Two processes are then described by which metallic replicas can be made which differ very little from the original ruling in resolving power and give remarkably brilliant spectra. R. S. R.

95. *Photophoresis.* **H. S. Patterson** and **R. W. Gray.** (Leeds Phil. Soc., Proc. 1. pp. 70–73, Jan., 1926.)—In a recapitulation of previous work on the subject, with particular reference to that of Halpern [see Abstract 1149 (1924)], it is considered that the failure of the theories advanced to account for the phenomena observed indicates the need for further experimental work. Ehrenhaft's experiments are qualitatively repeated, an arrangement being devised to permit of more convenient observation of the effects. The smoke or dust of the substance under examination is observed under reduced pressure, velocities of the order of 1 cm. per sec. being thus obtained. In the majority of cases both positive and negative photophoresis is obtained, and in no case is the negative effect observed without the positive, and the number of particles travelling with the light is always greater than that of those travelling against it. A change from light negative to light positive, or *vice versa*, is only rarely observed. A. B. C. L.

96. *G. N. Lewis's Note on the Path of Light Quanta in an Interference Field.* **R. C. Tolman** and **S. Smith.** (Nat. Acad. Sci., Proc. 12. pp. 508–509, Aug., 1926.)—In reply to Lewis [Abstracts 972 and 2836 (1926)], emphasis is laid on the possibility that quanta arriving on a screen at a position where interference occurs could be deflected, if necessary, to regions where the action of light is permitted by the wave theory. In the case of a highly absorptive material it is reasonable to expect a very sharp deflection of such quanta to neighbouring regions where they are needed to produce the reinforcement verified experimentally. [See Abstract 2057 (1926).] T. H. P.

97. *Possibility of Relating Interference and Diffraction Phenomena to the Theory of Light Quanta.* **L. de Broglie.** (Comptes Rendus, 183. pp. 447–448, Aug. 23, 1926.)—In this brief note a proof is outlined showing that in interference and diffraction phenomena the new light quanta optics leads to a value for the density of light quanta at a point which is proportional to the luminous intensity at that point required by classical optics. W. S. S.

98. *Interference and Corpuscular Light.* **L. de Broglie.** (Nature, 118. pp. 441–442, Sept. 25, 1926.)—According to the new wave theory of matter developed by Einstein, de Broglie and Schrödinger, it is shown that the density of light quanta is to be taken proportional to the classical intensity. Thus in dark interference fringes the density of quanta will be zero. The density is to be defined as a time average instead of a space average. F. S.

99. *Scattering of Light.* **A. Andronow** and **M. Leontowicz.** (Zeits. f. Physik, 38. 6–7. pp. 485–501, 1926.)—A relatively simple calculation for diffuse reflection from slightly roughened surfaces. The results are applied to the surface of a liquid irregularly roughened by thermal movements. For azimuths from 90° to 130° the theory is in good accord with the experimental data of Raman and Ramdas. A. D.

100. *Comparison between the Dispersion Formulæ of the Atomic and the Continuity Theories.* **F. Hlučka.** (Akad. Wiss. Wien, Ber. 135. 2a. No. 1–2. pp. 9–28, 1926.)—Considers the dispersion formulæ with three constants with a single natural oscillation. They are mathematically formally identical, *i.e.*, they are capable of representing the same curves, but with different values of the constants K and λ_0. These constants thus stand in the two theories in a definite relation to one another. This was investigated in the cases of NaCl and KCl, and found to be correct. Here as in other cases the value of λ_0 from the Ketteler-Helmholtz-Drude atomic formula is larger than that determined experimentally as the wave-length λ_R of the "residual rays" (maximum reflection), while that obtained from the Jaumann continuity formula is smaller than λ_R. The author has reconsidered the Jaumann theory, taking absorption into account, and finds that when this is done the formal identity between the formulæ no longer holds, but that now $\lambda_R/\lambda_0 > 1$ if, in accordance with experiment, λ_A, the wave-length of maximum absorption, is taken as approximately identical with λ_R. A series of accurate observations of complete absorption and reflection curves will be necessary to decide between the theories. H. N. A.

101. *Anomalous Dispersion in Stimulated Gases.* **R. Ladenburg, H. Kopfermann** and **Agathe Carst.** (Preuss. Akad. Wiss. Berlin, Ber. 20. pp. 255–273, 1926.)—Exact measurements undertaken of anomalous dispersion in the vicinity of series lines. Theoretical considerations. Methods. Results show variations with current-intensity, pressure, and temperature. Relative values of the probabilities of transition. Computation of the number of atoms in the S-condition in neon, and the absolute value of the probability of transition. A. D.

102. *Theory of Optically-Active Isotropic Media.* **V. Bursian** and **(Mrs.) A. Timorew.** (Zeits. f. Physik, 38. 6–7. pp. 475–484, 1926.)—In addition to the electric moment used by Born [see Abstract 934 (1918)] it is necessary to take into account a magnetic moment, which is of a similar order of magnitude. Equations embodying this principle are given in the paper. T. M. L.

103. *Photoelectric Densitometer.* (Engineering, 122. p. 403, Sept. 24, 1926.)—Describes a modification of the densitometer previously described [see Abstract 61 (1924)]. The present instrument, designed by F. A. Lindemann and G. M. B. Dobson, is arranged as a microphotometer, and the flicker device has been replaced by a simple change-over from one beam to another by a hand-operated shutter. J. W. T. W.

104. *Effect of Concentration of Sensitiser on Speed, with a Note on Fog Corrections.* **S. E. Sheppard.** (Eastman Kodak Co. Research Lab., Comm. No. 272. Phot. J. 66. pp. 399–409, Aug., 1926.)—In previous papers [see Abstract 2270 (1925)] on the photographic sensitising properties of thioureas and cognate bodies, reference was made to the existence of an optimum concentration of the sensitiser for its effect in a given emulsion. The principal results of the present paper are that the maximum and optimum sensitising effects observed with gelatine-extract sensitisers have been confirmed when using allyl thiocarbamide. The relation of inherent "fog" and "fog corrections" to the characteristic curve is discussed. Evidence is adduced that such fog ceases to contribute to the effective density at a certain exposure, which varies with the fogging coefficient and probably with the development. The bearing of "fog" upon available speed is dealt with, and attention is drawn to the magnitude of the silver sulphide sensitising effect. A. E. G.

105. *Distortion by Photographic Objectives.* **M. Paul.** (Rev. d'Optique, 5. pp. 328–334, Aug., 1926.)—Describes some of the methods for measuring the distortions introduced when the field is very large or if the objective is used considerably off the centre. The methods are suitable for use in aerial photography. W. H. Gr.

106. *Photographic Dark-Room Illumination and the Human Eye.* **H. Arens and J. Eggert.** (Zeits. Wiss. Phot. 24. pp. 229–248, Sept., 1926.)—Emphasises the importance of an illumination effective for the eye as well as for preventing fog. For each kind of plate there is an optimal mixture or rays which best meets these requirements. For unsensitised plates the best begins in the yellow-green, has its maximum in the orange, and falls off towards the red; this is 25 to 30 times as safe for the plate as the ordinary red light brought to an equal brightness; and with equal fog-safety the illumination for the eye is from 2½ to 25 times as great, and the eye is much less fatigued than it is by red light. The same principle applies to orthochromatic plates, but the maximum is farther towards the red. For panchromatic plates the maximum is in the green; but under some conditions an orange light is safer, but gives less light, though a watch can be more easily read. A. D.

107. *Ripening of Photographic Emulsion.* **W. Jenisch.** (Zeits. Wiss. Phot. 24. pp. 248–256, Sept., 1926.)—*Résumé* of recent work. In the later stages of ripening there is an uncontrollable formation of granules which contribute to the sensitiveness. These are formed not necessarily upon silver nuclei, but may be deposited upon nuclei of any kind of corresponding size, much as raindrops are deposited upon dust-nuclei in the air. A. D.

108. *Microtomes.* **J. Kisser.** (Zeits. Instrumentenk. 46. pp. 528–533, Oct., 1926.)—An investigation of the action of the knife in microtomes of various types. The sliding microtome is the best type. A. D.

109. *Phosphorescence of Nitrogen.* **J. C. McLennan, H. J. C. Ireton, K. Thompson.** (Nature, 118. pp. 408–409, Sept. 18, 1926.)—Solid nitrogen was excited by fast kathode rays produced under a potential of 125,000 volts from a specially designed Coolidge tube. The rays were projected into the vacuum space of a thermos flask cooled by liquid hydrogen, and the luminescence of the solid nitrogen observed and its spectrum photographed through a fluorite window in the flask. The spectra show (1) a single sharp band N_4 at 5945; (2) three broad diffuse bands N_1 shading into each other with mean wave-lengths 5554, 5617, 5658; (3) a series of eight clearly defined bands (N_2) at 5214·4, 5210·4, 5214·3, 5220·4, 5224·4, 5228·8, 5235, 5240; and (4) a number of faint diffuse bands each shaded off towards the red in the blue and violet region between 4500 and 2460. Some of these have already been observed by Vegard, and some appear to belong to the second positive band spectrum of nitrogen. Four points are noted specially: (1) Failure to record any trace of Vegard's N_3 group; (2) the N_1 group disappeared immediately on the cessation of the excitation, while N_4 and N_2 persisted some minutes; Vegard's suggestion that N_2 and N_4 belong to the phosphorescent spectrum of solid nitrogen appears confirmed; (3) the N_1 bands were strong with freshly deposited nitrogen but rapidly weakened under bombardment. The intensities of N_4 and N_2 appeared unaffected by bombardment. It is taken that these results show that solid nitrogen can exist in two forms A and B, A giving rise to N_1, and B to N_2 and N_4. The experiments support the view that solid nitrogen is first deposited as A and is transformed by bombardment into B. (4) The band N_2 is not, as originally observed by Vegard and by McLennan and Shrum, a sharply defined narrow band, but has eight components. As no band like this has ever been seen in the Aurora, it is concluded that Vegard's theory is not tenable. J. E.

110. *A Principle of Correspondence.* **E. O. Lawrence.** (Science, 64. p. 142, Aug. 13, 1926.)—Mercury vapour was bombarded by electrons of homogeneous velocities, the minimum ionisation potential was found to be 10·4 volts, and other critical potentials are approximately 10·6, 11·2, 11·6 and 11·9 volts. The probability of ionisation is finite at 10·4 volts and decreases to 10·6 volts, when there is a sharp rise; there is again a decrease to 11·2 volts and another sharp rise, and so on. The author compares this behaviour with that of radiation quanta in the X-ray region, and concludes that electrons and radiation quanta obey the same general laws in connection with the ionisation of atoms; the probability that an electron will produce a given type of ionisation, expressed as a function of its energy, is of the same form as the corresponding probability function for radiation quanta. A number of previously unintelligible experimental facts are examined and explained in the light of this postulate. H. N. A.

111. *Semi-Optical Spectral Lines.* **A. Carrelli.** (N. Cimento, 3. pp. 247–253, June, 1926.)—The jump of an electron from an inner level to a level not completely filled up is characterised by a "semi-optical" spectral line which has the property of being equal in absorption and in emission. There is a discrepancy between experiment and theory in regard to the energies of internal orbits. On the basis of Hund's recent classification of electrons [see Abstract 2692 (1925)] it is shown that for all the elements from K to Ga the N_{22} level is semi-optical. A. D.

112. *Gyration of Light by Multiplet Lines.* **C. G. Darwin.** (Roy. Soc., Proc. 112. pp. 314–336, Sept. 1, 1926.)—In a previous paper [see Abstract 1026 (1926)] the author, using a purely mechanical model, has shown that any atom which exhibits the Paschen-Back effect should give in a weak magnetic field and for light not too near the lines of the multiplet, a gyratory constant V conforming to the Becquerel relation $V = \frac{e}{2mc^2}\lambda\frac{dn}{d\lambda}$ with the normal value of e/m. This result is now confirmed for the

"electron and core" model, using the methods of Kramers and Heisenberg to calculate classically the gyration due to the whole multiplet. The effect of temperature on the gyration is also investigated and the existence established of a "paramagnetic" term in the gyration, inversely proportional to the temperature. A discussion is given of the quantum theory interpretation of the results obtained. The paper is mathematical.
W. S. S.

113. *Orientation of Atoms in a Magnetic Field.* **W. Schütz.** (Zeits. f. Physik, 38. 11–12. pp. 853–863, 1926.)—Three optical methods of investigation tried. The total polarisation of D lines split up in a magnetic field gave negative results. In Na vapour of 0·1 mm. pressure there exists in the transverse field of 2000 gauss no double refraction other than that normal to regions of abnormal dispersion; results negative. In H, CO_2 and air of 0·1 mm. pressure, and at room-temperature the transverse field of 15,000 gauss showed a difference in the refractive indices amounting to 0·03 % of the refraction. A. D.

114. *Series and Ionisation Potentials in the Iron Spectrum.* **O. Laporte.** (Nat. Acad. Sci., Proc. 12. pp. 496–503, Aug., 1926.)—A discussion is here given of the iron spectrum in a more detailed fashion than has been possible before. The discussion is based on the energy diagram of the iron spectrum, to which several terms have been added. The treatment shows how far the theory enables us to predict not only the existence but also the position of unknown terms, and such predictions are used for the establishment of several short series. Pauli's equivalence principle is demonstrated with a special group of terms, and it is shown that the theory is in complete agreement with empirical facts and serves as an efficient means for detecting new regularities. A. W.

115. *Fine Structure of Xenon and Krypton Lines.* **E. Gehrcke** and **L. Janicki.** (Ann. d. Physik, 81. 3. pp. 314–316, Sept. 17, 1926.)—The spectra of xenon and krypton were investigated, using as source both Geissler tubes and gas-filled arc lamps with alkali metal electrodes. In the case of xenon forty-two lines were examined, ranging from λ4079 to λ6768, but only two lines, λ4734·30 and λ4501·13, gave satellites. All the sixteen krypton lines from λ4274 to λ5871 appeared as simple and symmetrical. The green line λ5570 to which Pérard attributed a satellite [see Abstract 2171 (1923)], was specially investigated with a Fabry and Perot étalon, but again no satellite or asymmetry could be observed. W. S. S.

116. *Further Spectroscopic Studies on the Luminous Vapour Distilled from Metallic Arcs.* **(Lord) Rayleigh.** (Roy. Soc., Proc. 112. pp. 14–29, Aug. 3, 1926.)—In continuation of a previous investigation [see Abstract 2295 (1925)], spectroscopic observations are made on the jets of luminous vapour distilled from metallic arcs. It is shown that the appearance of high series members in the spectra of the luminous vapours is due to their narrowness. In the arc these lines are so broad as to overlap one another. As the vapour emerges and expands they become narrow and can be resolved. Enhanced lines occur in the distilled vapour though in diminished intensity relative to the arc lines. In some cases, *e.g.*, Mg, they fade out very rapidly compared with the arc lines. The resonance line of Hg 1S − $1p_2$ gains intensity relative to all other lines as the vapour matures. The same is true of Ca, but the corresponding line of Mg behaves in the opposite manner, dying out more quickly than the series lines in general. A luminous jet of one metallic vapour is able in many cases to excite the vapour of another metal injected into it. As a rule such excitation does not take place unless the ionisation potential of the first metal exceeds the excitation potential of the spectrum line in question. Possible explanations of observed exceptions to this rule are discussed. A. B. C. L.

117. *Series Spectra of Beryllium, Be_1 and Be_{11}.* **I. S. Bowen** and **R. A. Millikan.** (Phys. Rev. 28. pp. 256–258, Aug., 1926.)—The determination of the wave-lengths and term values of all the most important lines of Be_{11} and of the triplet system of Be_1 has been completed. The results are given in tabular form. AUTHORS.

118. *Observations of the Nitrogen Afterglow Spectra.* **R. C. Johnson** and **H. G. Jenkins.** (Phil. Mag. 2. pp. 621–632, Sept., 1926.)—A magnetic interrupter, which can be tuned so that the discharge in the tube can only be photographed when the current is off, has been found suitable for searching for afterglows in the ultra-violet. It also permits the detection of afterglows of short duration. The method has been applied to the cyanogen tail bands and the β-group of the nitrogen afterglow. Tables are given of the observed wave-lengths and intensities in each spectrum and the structure of the latter is discussed. F. S.

119. *Band System of Cyanogen as Developed in Active Nitrogen.* **W. Jevons.** (Roy. Soc., Proc. 112. pp. 407–441, Sept. 1, 1926.)—Rayleigh and Fowler [see Abstract 677 (1912)] described certain modifications in the λ4216 and λ3883 groups of CN bands developed in the afterglow of nitrogen. Modifications of the λ3590 group and some of the "tail" bands are now discussed with the aid of grating measures and the interpretations of Birge and Mulliken discussed. Bands of the λ3590 group are identified in Kayser and Runge's list by means of Heurlinger and Kratzer's formula. This group is shortened in the low-λ direction, but is prolonged in the high-λ direction in the afterglow as compared with the arc, and also consists of headless bands. Each source develops some lines which the other does not. The "tail" bands near λ3883 form similar headless branches in the afterglow. F. S.

120. *Fine Structure of Certain Cadmium Lines.* **W. A. MacNair.** (Nat. Acad. Sci., Proc. 12. pp. 555–556, Sept., 1926.)—Photographs of a number of lines from a water-cooled cadmium arc have been taken with two different quartz Lummer-Gehrcke plates crossed with a quartz prism—or a grating spectrograph. A table is given of the observed structures. Full experimental details are to be published subsequently. F. S.

121. *Structure of Cadmium and Zinc Resonance Lines.* **R. W. Wood.** (Phil. Mag. 2. pp. 611–612, Sept., 1926.)—The author has examined the fine structure of the 1S − $2p_2$ and 1S − 2P, the resonance lines of Cd and Zn analogous to the 2536 line for mercury [see Abstract 300 (1926)]. The source of light in each case was a metallic arc in a tube of fused quartz furnished with an anode of tungsten wire. The tube was continuously exhausted by a mercury-vapour lamp during its operation, and the kathode bulb, which contained the metal, was immersed in water. The fine structure of the lines was photographed with two quartz Lummer-Gehrcke plates used in succession. The lines of Cd and Zn examined were much simpler than the corresponding Hg line. The fringes formed by the interference plates were focussed on the slit of a small quartz spectrograph by means of a quartz-fluorite objective of 40 cm. focus. The structure of the Cd lines obtained in this way is shown in a plate. R. S. R.

122. *Fine Structure of Certain Lines and Energy Levels of Cadmium.* **W. A. MacNair.** (Phil. Mag. 2. pp. 613–621, Sept., 1926.)—Light from a cadmium arc was analysed by a quartz Lummer-Gehrcke plate, the fringe systems being focussed upon the slit of a spectrograph. Two plates were used and photographs taken with two quartz spectrographs and two grating spectrographs. Reproductions of the structure of a number of lines are given as well as tables of measurements. In the second half of the paper the corresponding energy levels are discussed. F. S.

123. *Absorption and Resonance Radiation in Excited Helium and the Structure of the 3889 Line.* **W. H. McCurdy.** (Phil. Mag. 2. pp. 629–638, Sept., 1926.)—Results of these experiments on the optical properties of excited helium may be summarised as follows: Excited helium shows marked absorption for terms of both the principal and diffuse subordinate series of the two systems of the helium spectrum. Resonance radiation of wave-length 3889 Å. has been observed in the weakly excited gas under the influence of monochromatic radiation of this wave-length. Examination of the structure of the 3889 line of helium has shown it to be a doublet in agreement with the rest of the spectral system. The second component is weak and of wave-length 0·044 Å. less than the main component. AUTHOR.

124. *Intensity Variations in the Spectrum of Neon.* **Mary R. Johnson** and **R. C. Johnson.** (Phil. Mag. 2. pp. 593–611, Sept., 1926.)—A neutral tinted wedge, as used by Merton and Nicholson [see Abstract 1132 (1917)], was employed. All photographic intensities are converted to absolute values by comparison with the radiation from the positive crater of the carbon arc (taken as black-body radiation at 3750 Å.), and all referred to that of λ6402 as 100·0. For the visible spectrum tables record the effects of current density, ordinary, condensed and "bulb" discharge, high and low pressure, admixture of H, A, He and CO_2, and the intensity distribution as a function of the distance from a flat kathode. As measurements in the ultra-violet are not available, a comparison of the various principal series among themselves only is attempted. It was found that the various principal series of any one group diminish in intensity with decreasing wave-length. The bulb and condensed discharges enhance all the principal series, and the degree of enhancement in any group increases with decreasing wave-length. The effects of increased pressure are different for various wave-lengths. High pressure tends to throw the energy into the principal series at the expense of the subsidiary series, but very low pressure acts oppositely. A trace of H produces little effect on all the lines, but for the s_3 group gives an intensity displacement to the shorter wave-lengths, while more H reverses the effect. Argon reduces the intensity very much, and more A causes complete disappearance but the effects are irregular through the spectrum. He produces effects for which at present no definite rules can be given, while CO_2 causes the kathode glow to contract. R. S. R.

125. *Spectrum of Argon.* **F. A. Saunders.** (Nat. Acad. Sci., Proc. 12. pp. 556–560, Sept., 1926.)—Meissner [see Abstract 2355 (1926)] has given a grouping of red and infra-red lines which in the main is verified by the results now published which are based on photographs in the extreme ultra-violet and throughout the ordinary range of spectrum. Tables of terms are given for the principal and subordinate series and of wave-lengths in the extreme ultra-violet. The ionisation potential is deduced as 15·69 volts compared to Hertz's values of 15·3 volts. A number of combinations are discussed which violate the rules of selection. F. S.

126. *Rubidium and Cæsium-like Doublets of Stripped Atoms.* **R. C. Gibbs** and **H. E. White.** (Nat. Acad. Sci., Proc. 12. pp. 551–555, Sept., 1926.)—It has been shown [see Abstract 2866 (1926)] that it is possible to apply the regular and irregular doublet laws to elements in the same rows with rubidium and with cæsium. In the present paper diagrams and tables are given showing the almost linear progression with atomic number of the $(5s - 5p_2)$, $(5s - 5p_1)$ doublets of RbI, SrII, YtIII and ZrIV as well as the $(6s - 6p_2)$, $(6s - 6p_1)$ doublets of CsI, BaII, LaIII, CeIV and PrV. F. S.

127. *The Apparently Too Small Polarisation of Resonance Radiation in a Magnetic Field.* **E. Gaviola** and **P. Pringsheim.** (Zeits. f. Physik, 39. 1. pp. 75–76, 1926.)—Specifies a correction to be applied in connection with a previous investigation [see Abstract 289 (1926)]. A. D.

128. *Oxygen Spectral Line $\lambda = 5577 \cdot 35$ Å.U.* **J. C. McLennan, J. H. McLeod** and **W. C. McQuarrie.** (Nature, 118. p. 441, Sept. 25, 1926.)—The main characteristics of this line have been studied in view of the suggestion of McLennan and Shrum that it is identical with the famous "green line." It has been found to be obtainable with pure oxygen at 2 mm. pressure when the discharge is passed through a tube one metre long; the intensity to increase with current; the wave-length to be very close to 5577·35 Å.; to be greatly enhanced by rare gases, especially argon; to be without any fine structure, and to broaden symmetrically in a magnetic field. F. S.

129. *Hicks's Addition Spectrum Series.* **A. T. Williams.** (Univ. Nac. La Plata, Estudio Ciencias, Serie Mat.-Fis. 71. pp. 453–487, March, 1926.)—These series may be represented by a difference of the form $2A - \psi(m) = \nu$, in which A represents, for each series, the limiting frequency of the normal series and $\psi(m)$ the frequencies of the different lines of the normal series. The series so calculated (inverse series) present a constant term of twice the value of that in the normal series, and the separation between the different lines of a series becomes successively smaller as the wave-length increases, contrary to what happens in the normal series. Calculating in this way, with the aid of Fowler's report, the wave-lengths of the inverse series of Li, Na, K, Rb, Cs, Cu, Ag, Ca, Zn and Hg, and comparing these with the experimental results of various authors, especially those on induction spectra by Bloch, Dunoyer, McLennan and others, the author has found numerous coincidences with varying grades of precision. He concludes that the Hicks series have no physical significance and are simple numerical coincidences, because the lines which numerically belong to such a series are not of the same order; one and the same such series will contain arc-lines and lines of differing sparks, with unrelated intensities. Besides, it would be necessary to establish new electronic conformations and new rules of quantification before these series could be experimentally realised, because calculation of the aphelia and perihelia of the orbits shows these to present imaginary values, with the existing atom-models. A. D.

130. *Lines of Transformation Products of Uranium and Thorium in the Spectra of these Elements.* **H. Nagaoka** and **T. Futagami.** (Imp. Acad. Tôkyô, Proc. 2. pp. 318–323, July, 1926. In English.)—An attempt is described to identify the spectral lines of the transformation products of uranium and thorium in the spectra of these elements by making use of the fact that isotopes have the same spectra. For example, RaC, RaE, AcC, and ThC are isotopic with Bi, and if the spectrum of Bi is compared with those of ordinary uranium and thorium, the line 3067·8 is found to be common to all. It is pointed out that care must be exercised in arriving at these common lines, as the spectrum lines are sufficiently numerous to make accidental coincidence not improbable. W. S. S.

131. *Helium Lines in the Spectra of Uranium and Thorium.* **H. Nagaoka** and **T. Futagami.** (Imp. Acad. Tôkyô, Proc. 2. pp. 324–327, July, 1926. In English.)—During the various transformations occurring in uranium or thorium preparations α-particles are ejected which by acquiring electrons become helium atoms. Helium lines may therefore be expected to appear in the spectra of such preparations. Furthermore, in the case of α-particles combining with electrons, the conditions of excitation of the lines are rather different from those of the electric discharge in a Geissler tube, and it is possible that lines not normally found in the spectrum of helium may be present in the spectra of Ur and Th. Some of these lines known only by calculation were deciphered, particularly in the Ur spectrum. A noteworthy feature is the appearance of doublets suggesting an electric or magnetic field such as might easily be imagined if the lines arise from ejected α-particles collecting electrons in their passage through the atom. W. S. S.

132. *Fundamental Terms of Spectra of First and Second Periods.* **O. Laporte.** (Zeits f. Physik, 39. 2–3. pp. 123–129, 1926.)—A modification of a rule given by Kiess and Laporte is here discussed. By means of it the lower terms of spark spectra and their mutual difference from the arc spectra can be predicted, and inversely. A. E. G.

133. *Multiplets in the Spectrum of Ionised Vanadium.* **W. F. Meggers.** (Zeits. f. Physik, 39. 2–3. pp. 114–122, 1926.)—A continuation of a previous paper [Abstract 2509 (1925)] on multiplets in the spark spectra of vanadium. The paper is largely tabular and does not, therefore, lend itself to abstraction. B. J. L.

134. *Study of Non-Electrode Luminous Hydrogen.* **M. Schlesinger.** (Zeits. f. Physik, 39. 2–3. pp. 215–225, 1926.)—Luminosity produced without electrodes has been found an especially convenient method for the production of line spectra, and for providing the possibility of the experimental explanation of atomic processes. In this paper the author records intensity measurements for the red and blue hydrogen lines and for the conductivities during the light emission. The measurements were carried out for different gas pressures. H. H. Ho.

135. *The Components of the KB Line of Iron and its Compounds.* **G. Ortner.** (Akad. Wiss. Wien, Ber. 135. 2a. No. 1–2. pp. 71–77, 1926.)—The KB_1 line of iron is made up of two components—a shorter wavelength B_2 and a longer B′. This investigation as to how the lines depend on the chemical state of the iron was made with a spectrograph of 125·2 mm. radius with a calcspar crystal. With iron as *element* B′ is not resolved from B_1, but the whole appears as a widened line. With compounds of iron, however (ferrous sulphate; ferrous ammonium sulphate; sulphide; ferro-ferri oxide; ferric sulphate; ferric oxide and phosphate), the components are resolved. With potassium ferricyanide and ferrocyanide the components are not resolved. The separation of the middle of the B′ to the middle of B_1 is, however, 3·4 and 3·8 × units (10^{-11}). B_2 is, with the compounds studied, only half as strong as with the element and not so sharp. J. E.

136. *Neon and Helium Spectra in the Extreme Ultra-Violet.* **H. B. Dorgelo** and **J. H. Abbink.** (Zeits. f. Physik, 37. 9. pp. 667–671, 1926.)—The spectra of a neon and a helium discharge were observed in the extreme ultra-violet. The following neon lines were found: **743·74 Å.** ($1p - 2s_4$), **735·97 Å.** ($1p - 2s_2$), **629·76 Å.** ($1p - 3s_4$), **626·82 Å.** ($1p - 3s_2$), **619·09 Å.** ($1p - 3d_5$), **618·63 Å.** ($1p - 3d_2$), **615·59 Å.** ($1p - 3s_1$), **602·69 Å.** ($1p - 4s_4$), **600·03 Å.** ($1p - 4s_2$), **598·77 Å.** ($1p - 4d_{2\cdot5}$), **595·83 Å.** ($1p - 4s'_1$), **591·70 Å.** ($1p - 5s_4$), **589·84 Å.** ($1p - 5d_2/5s_2$). In the photographs of neon (with only a little helium) the $1p - ms_2$ line is stronger than $1p - ms_4$. On the other hand, the $1p - 2s_4$ line of neon is stronger than the $1p - 2s_2$ line if one uses as source a discharge in helium with only a trace of neon. The following helium lines were found: **584·33 Å.** ($1s - 2p$), **537·08 Å.** ($1s - 3p$) and **522·17 Å.** ($1s - 4p$). The line **600·03 Å.** given by Lyman is placed as a neon line $1p - 4s_2$, which is excited by collision with the metastable $2s$ states of helium. W. V. M.

137. *Measurements of the Absorption Spectrum of p-Benzochinone Vapour.* **I. Lifschitz** and **E. Rosenbohm.** (Zeits. f. Physik, 38. 1–2. pp. 61–71, 1926.)—The paper consists chiefly of the results of measurements made in the region 2000–5000 Å. on the spectrum of chinone vapour, an absorption spectrum of some interest in view of its structures possibly being intimately connected with colour phenomena. The compound has in this part of the spectrum three absorption regions, the long-wave portion of which (4800–4200) consists of a band spectrum rich in lines. About 300 have been measured and wave-lengths tabulated. The next absorption region (3100–2600) shows only narrow continuous streaks. The spectrum of the vapour was compared with that of dissolved chinone, the origin of the former discussed and some remarks added on the spectra of such substitution products as monochlorochinone and chloranil. W. V. M.

138. *Arc Spectrum of Europium between* $\lambda 3500$ *and* $\lambda 3100$ *I.A.* **S. P. Rubies.** (Comptes Rendus, **183.** pp. 385–387, Aug. 9, 1926.)—Pure europium and fractions *Eu—Gd* and *Eu—Sm*, prepared by Urbain, have been investigated. All the lines found by Eder in a sample prepared by Urbain have been confirmed, but six lines found by Eder in a sample by Auer are now lacking. A list is given of lines now to be attributed to *Eu* which have not been given before, although found in the spark spectrum. F. S.

139. *Red Cadmium Line in Vacuum Arc and Discharge Tube.* **F. L. Brown.** (Optical Soc. America, J. and Rev. Sci. Inst. **13.** pp. 183–192, Aug., 1926.)—As a cadmium arc *in vacuo* had been used in interferometer measurements of the spectrum of titanium, it was determined to compare this arc with the Michelson tube. Four quartz étalons of 5, 10, 20 and 30 mm. length were used and simultaneous photographs taken with a constant deviation spectroscope. A mercury arc and neon tube were used as comparison sources. It is concluded that the red line does not differ by as much as 0·001 Å. from the two sources. F. S.

140. *Series Spectra of Palladium.* **J. C. McLennan** and **H. G. Smith.** (Roy Soc., Proc. **112.** pp. 110–128, Aug. 3, 1926.)—The preliminary analysis of the arc spectrum [see Abstract 2366 (1926)] has now been extended, use being made of Beal's work on the Zeeman effect, the experiments of McLennan and Cohen, and McLennan and Liggett on absorption of vapour, and Megger's measurements between 4500 Å. and 9000 Å. This spectrum is fully discussed with reference to recent theory. The spectrum of palladium II has also been partially analysed, Dhein's values as far as 2000 Å., Kail's from 2000 to 1850 Å, and McLennan and Liggett's for the Schumann region being used. Tables of terms and of the lines identified in this spectrum are given. The regular arc spectrum of palladium, involving disturbances of a single electron outside a core of nine 4_3 electrons, includes very nearly all the strong lines of the arc and most of the faint lines of wave-length longer than 3400 Å. F. S.

141. *Structure of the Arc Spectrum of Gold.* **J. C. McLennan** and **A. B. McLay.** (Roy. Soc., Proc. **112.** pp. 95–110, Aug. 3, 1926.)—The absorption measurements of the normal vapour of gold [see Abstract 2299 (1925)] have been repeated in the quartz region and supplemented with those of the under-water spark. Emission wave-lengths have also been measured or taken from Kayser's handbook. The recent theory of Pauli, Heisenberg and Hund is then expressed as a number of rules which are applied to the spectra of AuI and AuII. Nearly all the wave-lengths have been classified, but six which are absorbed by vapour in the under-water spark have not been identified. F. S.

142. *The Infra-Red Secondary Spectrum of Hydrogen.* **T. E. Allibone.** (Roy. Soc., Proc. **112.** pp. 196–212, Aug. 3, 1926.)—Specially sensitised plates were employed to photograph a large number of lines in the many-lined spectrum of hydrogen in the infra-red. A table gives the measured wave-lengths with the corrected wave numbers and wave-lengths measured by previous observers; photographs are reproduced. An extension has been made to Fulcher's first band in all seven series. A term Dm^3 is required in the formula to represent these adequately. The effect of a magnetic field was investigated. No selective effect could be detected, but there was a general broadening of all the lines. H. N. A.

143. *A High-Vacuum X-Ray Spectrometer.* **M. Siegbahn** and **R. Thoraeus.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 235–242, Aug., 1926.)—The authors have previously described an X-ray spectrometer for soft X-radiations in which the tube and spectrometer, separated by a foil window, were both evacuated to an equal degree. [See Abstract 757 (1926).] A description is now given of a combined spectrometer and metal X-ray tube, and its use is described. By the employment of crystals of calcite, mica, or palmitic acid a long spectral range from 3·5 Å.U. to 40·0 Å.U. can be covered. B. J. L.

144. *Radiation from High-Resistance Cells—Analysis at Reduced Pressure.* **G. Reboul.** (J. de Physique et le Radium, 7. pp. 275–288, Sept., 1926.)—The author has shown that a body of high electric resistance when suitably disposed and traversed by a current emits a radiation of wave-length intermediate between ultra-violet and X-rays. The first experiments were made in air at ordinary pressure; they have now been repeated in air at reduced pressure, in hydrogen and in CO_2. The radiation studied comprises: (*a*) The radiations forming a continuous spectrum lying in the range from several tens to several hundreds of Ångström units; (*b*) slow kathode rays corresponding to a fall of potential of several hundreds to several tens of volts; (*c*) positive nuclei analogous to anode rays of very low velocity. A. B. W.

145. *X-Rays—Internal Absorption and "Spark" Lines.* **H. Robinson.** (Nature, 118. p. 224, Aug. 14, 1926.)—A preliminary note on the work of the author and A. M. Cassie on the process of internal absorption of an X-ray by the atom in which it is excited. (A complete account of the investigation is in preparation.) This type of absorption has played an important part in the elucidation of β- and γ-ray spectra and has been fully discussed by Ellis and Skinner in Great Britain, and by Meitner, de Broglie, Thibaud and others. In the author's experiments the secondary kathode rays emerging from a target irradiated by X-rays are drawn out out into a magnetic spectrum, and their energies are measured as in earlier work by de Broglie, Whiddington, Robinson and others. The corpuscular spectra show many lines which are due to the internal conversion of the X-rays or alternatively to radiationless readjustments within the atom which lead to the expulsion of "photoelectrons of the second kind." The origin and importances of these lines is discussed. A. B. W.

146. *X-Ray Absorption in Crystalline Compounds.* **R. J. Havighurst.** (Nat. Acad. Sci., Proc. 12. pp. 477–479, Aug., 1926.)—On the assumption that the mass absorption coefficient for X-rays in a compound is the sum of that for the component atoms and is independent of the physical state of the absorber, Compton's empirical formula for atoms becomes, for compounds, $\mu/\rho = (C\lambda^3\Sigma N^4 + 0\cdot 32\Sigma N)/\Sigma A$. By measurements made upon compressed slabs of the crystals in powder form this formula is confirmed for NaCl, NaF, CaF_2 and $CaCO_3$ when $\lambda = 0{\cdot}71$ Å. It fails for pure LiF, probably because the atomic number of Li is 3 whilst the Compton formula holds for elements of atomic number greater than 5. Single crystals of NaCl and CaF_2 were also studied. W. H. Ge.

147. *Relative Intensities of Reflection of X-Rays from the Principal Atomic Planes of Powdered Sodium Chloride.* **L. Harris, S. J. Bates** and **D. A. McInnes.** (Phys. Rev. 28. pp. 235–239, Aug., 1926.)—Measurements have been made on the relative intensities of reflection of the alpha doublet of characteristic molybdenum X-rays from powdered sodium chloride, using the modified Bragg apparatus described in a previous communication. Determinations were made with (*a*) filtered rays, and (*b*) rays reflected from a calcite crystal. In a separate investigation the lines were obtained on photographic plates and their intensities were found photometrically. All three series gave results that are in agreement with the measurements of Bragg, James and Bosanquet on large crystals, after their results are corrected for their determinations of the "extinction" in those crystals. Our experiments thus indicate that results on measurements with 325 mesh powder are as free from the effects of "extinction" as are the results of the workers just mentioned. Authors.

148. *Refraction of X-Rays by Small Particles.* **R. v. Nardroff.** (Phys. Rev. 28. pp. 240–246, Aug., 1926.)—The broadening of a beam of X-rays passed through a mass of small particles is investigated mathematically. It is shown that if the width of the beam, as given by the rocking curve of the second crystal of a double X-ray spectrometer, is W_0 before passing through the refracting material and w afterwards, then $w^2 - w_0^2 = 8\delta^2 n_0(\log 2/\delta + 1)$, δ being equal to $1 - \mu$, the refractive index of the material and n_0 being the average number of particles passed over. The radius of the particles may be found from the expression $R = 3VD/4n_0$, where V is the volume of refracting material per cm. and D the thickness of the material passed through. The above expressions are checked by experiments on graphite as to their dependence on δ, and quantitatively by measurements on graded aluminium powder. Author.

149. *Energy of High-Velocity Electrons.* **M. W. White.** (Phys. Rev. 28. pp. 247–255, Aug., 1926.)—The total heat generated in an X-ray tube operated at potentials up to 25,000 volts was measured by immersing a Coolidge X-ray tube of the water-cooled type in an oil bath and noting the temperature rise of the oil for a precisely measured energy input. The current and voltage furnished to the tube by a high potential d.c. source were kept constant and were continuously measured by potentiometers. The heat energy given up to the oil by this "high potential" source was compared with that developed by the same quantity of "low potential" energy by taking alternate runs wherein the same potentiometers measured the current and voltage supplied from a storage battery to a heating coil immersed in the oil. The data proved with a probable error of about 0·2 %, that, up to 25,000 volts, all of the energy input into a Coolidge tube is ultimately transformed into heat, and that any sources or sinks of energy which may exist have a smaller effect than 0·2 %. Ionisation, photographic and pyrometric methods were used to test for the presence of radiations involving an absorption of energy at the kathode. No appreciable quantity of such energy could be detected. The results of these experiments indicate that all of the input energy must go into the energy of the moving electrons and their fields. It also follows that only a negligible portion of the current in a Coolidge tube is furnished by positive ions which actually reach the kathode, for otherwise the kathode would be heated. AUTHOR.

RADIOACTIVITY.

150. *Half-Value Period of Mesothorium* 2. **O. Hahn and O. Erbacher.** (Phys. Zeits. 27. pp. 531–533, Aug. 15, 1926.)—The authors prove the non-existence (to the extent of less than 1 part in 10,000,000) of ekacæsium as a decay product of actinium. The decay period of mesothorium 2 has been carefully redetermined and a mean value of 6·13 hours obtained, *i.e.*, the decay constant $\lambda = 0{\cdot}113$ hours^{-1}. A. B. W.

151. *The Origin of the Penetrating Radiation of the Atmosphere.* **F. Běhounek.** (Phys. Zeits. 27. pp. 536–539, Aug. 15, 1926.)—A reply to criticisms of a previous paper made by V. F. Hess and by W. Kolhörster; the author corrects a formula employed in the original paper, and explains why his measurements were made at St. Joachimsthal, where the radioactivity of the ground is large. The thickness of lead employed for screening the instrument was so large that variations in the radiation from the ground could have had no effect. The results of Otis and Millikan and of Myssowsky and Tuwim are considered, and seem to confirm the author's conclusions, which were of a negative character. H. N. A.

152. *Anomalous Scattering of α-Rays.* **E. Guth.** (Phys. Zeits. 27. pp. 507–509, Aug. 1, 1926.)—Examines the results of Blackett obtained with the Wilson cloud apparatus in nitrogen, and finds evidence of supernormal scattering for large angles of scattering, of subnormal scattering for angles of 45° and under, with presumably normal scattering for still smaller angles. This corresponds to the behaviour of α-rays in Mg and Al as observed by Rutherford and Chadwick. The bearing of the results on nuclear theory is considered; there appears to be some evidence that union of the colliding α-particle with the nucleus only takes place under the conditions which produce supernormal scattering. The possibility that the nucleus has the form of a ring is also considered. H. N. A.

153. *The α-Rays of ThC + C′ and their Behaviour in Passing through Different Gases.* **L. Meitner and K. Freitag.** (Zeits. f. Physik, 37. 7–8. pp. 481–517, 1926.)—A form of Wilson cloud apparatus is described which makes it possible to take a large number of photographs at short intervals, on which the ranges of the α-rays can be measured accurately; 3000 such photographs have been taken for the present investigation. The ratio between the numbers of the α-rays sent out by ThC and ThC′ respectively was determined by counting to be 34·3 : 65·7, this is in good agreement with the value obtained by Marsden and Barratt by the scintillation method. The ranges in different gases were measured within 1 % of accuracy, and from these the mean relative braking powers were calculated; the results were compared with those calculated by Bohr from theory, and good agreement was found. Rutherford and Wood's group of α-rays with 11·5 cm. range in air was confirmed, and a new group with 9·5 cm. range determined. The experiments did not confirm the existence of α-rays with ranges longer than 12 cm. which Bates and Rogers claim to have observed, tracks longer than 12 cm. are shown to be due to H-particles. It was found that 10^6 ordinary α-particles from ThC′ were on the average accompanied by 200 with 11·5 cm. range and 70 with 9·5 cm. range. H. N. A.

154. *Reflection of α-Particles by Atomic Nuclei. Part II.* **G. Kirsch** and **H. Pettersson.** (Akad. Wiss. Wien, Ber. 134. 2a. No. 9–10. pp. 491–512, 1925.)—The work described in a previous paper [see Abstract 1679 (1925)] on particles reflected at angles considerably greater than a right angle has been continued. The apparatus recently described by E. A. W. Schmidt and one with Pettersson's ring formed α-ray source were employed in the present work, and details are given as to the methods employed in counting the scintillations. A large number of observations is recorded on some of the heavy elements and those of medium weight, which in a number of instances appear to indicate that in addition to α-particles H-particles are sent back to the screen. Many of these seem to have ranges no greater than those of the α-particles. The experiments are regarded as being of a preliminary character, but they appear to indicate that even with the heaviest metals the energy and impulse law does not hold if the α-particle and the nucleus struck are regarded as being unaltered during the process. H. N. A.

155. *Photographic Action of Natural H-Rays.* **M. Blau.** (Akad. Wiss. Wien, Ber. 134. 2a. No. 9–10. pp. 427–436, 1925.)—The method used was similar to that by which Michl photographed the tracks of α-rays in a photographic film. A polonium preparation sends α-rays through a thin layer of parafin, from which H-particles are split off, and these pass on through a thin copper foil which cuts off the α-rays. The H-rays fall obliquely on a photographic plate through a narrow oblique slit, and though the number that pass through is small, so that long exposures are necessary, a number of tracks were found, formed of a series of black points on the developed plate, which could be ascribed to the action of the H-rays, and were similar to those found by Michl with α-rays. The maximum theoretical length of the tracks was calculated to be 53 μ, and the longest observed was 46 μ long. The tracks sloped down into the photographic film at the angle at which the H-rays were sent in. H. N. A.

156. *Determination of e/m for Natural H-particles and H-particles from Aluminium.* **G. Stetter.** (Akad. Wiss. Wien, Ber. 135. 2a. No. 1–2. pp. 61–69, 1926.)—A method is described for the determination of *e/m* for H-particles obtained from different sources by α-particle bombardment. The values of *e/m* were determined by the use of combined electric and magnetic fields, a mass-spectroscope, on the lines of Aston's focussing mass spectrograph, being used for the purpose. H-particles produced by the bombardment of paraffin wax with α-particles were found to have the same *e/m* as "natural" H-particles—the agreement lying within 1 %. Particles reflected from aluminium were found to have *e/m* values corresponding to $\frac{1}{4}(\alpha^+)$, $\frac{1}{2}(\alpha^{++})$, and $1(H^+)$, the greater number of particles falling in the $(\frac{1}{2}\alpha^{++})$ group. A. B. W.

HEAT.

157. *Recording Dilatometers.* **P. Chevenard.** (J. de Physique et le Radium, 7. pp. 240–249, Aug., 1926.)—Several automatic instruments are described which are designed for industrial research connected with the expansion of alloys, glasses, and other substances. The temperature is found from the expansion of a standard substance, pyros, a nickel-chrome-tungsten alloy, which has an almost rectilinear expansion between 200° and 1000° C. The expansion is magnified by using an optical or mechanical lever. [See also Abstract 1386 (1926).] G. E. A.

158. *Specific Heat of Ferromagnetic Substances.* **W. Sucksmith** and **H. H. Potter.** (Roy. Soc., Proc. 112. pp. 157–176, Aug. 3, 1926.)—Contains the results of experiments on Heusler alloy and nickel to investigate the Weiss hypothesis that the specific heat should rise to a maximum at a critical temperature and then decrease discontinuously. [See Abstract 1496 (1908).] The Nernst-Eucken method of measuring the specific heat was extended to temperatures up to 410° C. The specific heats of Heusler alloy and nickel were measured up to temperatures considerably above their critical points, without discontinuities in the specific heat values being found. Magnetic measurements were obtained simultaneously in order to investigate the relationship between the two effects. Heat treatment of Heusler alloy showed a considerable reduction in the saturation intensity of magnetisation without a corresponding decrease in the value of the specific heat, and the experimental results do not appear to agree with the Weiss theory. M. G. S.

159. *Specific Heats of Silver and Diamond at High Temperatures.* **A. Magnus** and **A. Hodler.** (Ann. d. Physik, 80. 8. pp. 808–822, Aug. 21, 1926.)—The large Magnus copper calorimeter was employed in the measurements, the temperature differences between a block of copper forming the mixture calorimeter, and a large vessel of water at room-temperature, being measured at intervals of five minutes, before and after the heated body was dropped into it; a thermopile was employed for this purpose, and the differences were read to 1/20000° C. In the case of silver, observations were made with the electric oven at temperatures from 500 to 900° C. at 50° intervals. The heat Q given up by a gramme-atom is expressed as a function of the temperature by the equation $Q = 5 \cdot 88t + 5 \cdot 11 \times 10^{-4}t^2 + 8 \cdot 4 \times 10^{-7}t^3$, which gives for the atomic heat $(dQ/dt)_0 = 5 \cdot 88$; this agrees remarkably well with Nernst's value 6·00. The true atomic heat of silver as a function of the temperature is calculated to be $C_p = 6 \cdot 047 + 7 \cdot 49 \times 10^{-4}t + 7 \cdot 12 \times 10^{-7}t^2$ and $C_v = 5 \cdot 861 - 0 \cdot 000254T$. In the case of the diamond $C_p = 1 \cdot 2529 + 10 \cdot 194 \times 10^{-3}t + 8 \cdot 4315 \times 10^{-6}t^2 + 2 \cdot 6432t^3 \times 10^{-9}t^3 - 0 \cdot 595 \times 10^{-12}t^4$. An attempt to calculate the elasticity constants of diamond by Born's method from the above equation gave no satisfactory result. H. N. A.

160. *Latent Heat of Dilution of Cane-Sugar Solutions.* **Freda M. Hunter.** (Faraday Soc., Trans. 22. pp. 194–206, July, 1926.)—It can be shown on thermodynamical grounds that the heat of dilution of a solution is connected with the osmotic pressure by the nearly exact equation $H_t = \omega T^2 d/\partial T(P/T)$, where H_t is the heat absorbed when 1 gramme of the solvent is added to a very large quantity of solution, both being at the same temperature and pressure and ω the shrinkage. In order to check the determinations of osmotic pressure made directly, a complete set of values of the latent heat of dilution is necessary at different concentrations and temperatures. A method was worked out for determining the latent heat of dilution of solutions at different temperatures, and a formula was obtained whereby the heat of dilution can be calculated for any concentration and temperature. F. J. B.

161. *Variation of Pressure with Temperature in Evacuated Vessels.* **Research Staff of the General Electric Co., London.** (Phil. Mag. 2. pp. 369–383, Aug., 1926.)—The changes in pressure associated with changes in temperature in well baked and well exhausted glass vessels have been investigated. The vessels were made up as ionisation gauges and were constructed from four different types of glass varying considerably in chemical composition. Tungsten filaments were used in all cases as the kathode, and the grid and the anode were of nickel, molybdenum or tungsten. When such vessels are carried through a cycle of heating and cooling a condition is rapidly reached in which the pressures are functions of the temperatures of heating and cooling and are repeatable. The nature of the function varies also with the composition and the manner of preparation of the glass. If to the heating and cooling an additional stage of "cleaning up" by kathodic discharge is added, both the initial and final pressures of the cycle decrease asymptotically to values which are again functions of the initial temperature, but which now depend much less upon the constitution and preparation of the vessel. This behaviour is modified when the walls of the vessel are coated with a layer of metal (Ni, Mo, W) in that the "clean up" does not produce the progressive permanent change, but only a temporary reduction of pressure. Coating the walls with Mg, Zn, Cu, and Ag introduced subsidiary complications. The main constituents of the residual gas appear to be water and carbon dioxide. The theory, very tentatively suggested, explaining these observations is that the discharge, besides promoting absorption, induces a chemical reaction leading to the permanent removal of some of the gas. The glass is assumed to be capable of absorbing into solution from the atmosphere both water and carbon dioxide, and this solution by its vapour pressure prevents the indefinite lowering of the internal pressure by the discharge. The bearing of these results upon high vacuum technique are discussed, and a reason is given for the impossibility of reducing the pressure in metal coated vessels by prolonged baking of the glass, although the absorbed gas may readily be removed by heating the metal coating only and not the glass. T. B.

162. *Thermometry.* **W. F. Higgins.** (Roy. Soc. Arts, J. 74. pp. 946–959, Sept. 3; 962–976, Sept. 10, and pp. 978–986, Sept. 17, 1926. Cantor Lectures.)—The lectures embraced a survey of the history of thermometers, their uses, calibration, and a full description of the chief points of thermometry up to date. S. G. B.

163. *The Effect of Acetone as an Impurity in Spirit Thermometers.* **W. F. Higgins.** (Journ. Sci. Instruments, 3. pp. 361–365, Aug., 1926.)—In an attempt to explain the fall of reading noted over a period of some years in the case of certain spirit thermometers, experiments have been carried out to ascertain the effect of the presence of acetone, in the filling liquid, upon the readings of spirit thermometers over a period of time. It is found that in the case of spirit thermometers containing acetone a marked fall of reading is obtained in course of time when the thermometers are exposed to light. It is suggested that the effect is due to the contraction of the liquid consequent upon the formation of condensation products from the acetone under the influence of light. Acetone is known to be a common impurity in commercial methylated spirit, and it is shown that the use of this material either in the commercial or redistilled form should be avoided in the construction of spirit thermometers. No objection appears to attach to the use of pure ethyl alcohol, acetone-free methyl alcohol or a mixture of these two substances. AUTHOR.

164. *Some Considerations on Radiation Pyrometers.* **A. J. Philpot.** (Journ. Sci. Instruments, 3. pp. 366–373, Aug., 1926.)—The effect of varying the distance from the radiating source in total radiation pyrometers of the focussing and non-focussing lens and mirror types is considered theoretically and illustrated by experiments. AUTHOR.

165. *Absorption Wedge Pyrometry.* **G. Ribaud.** (Rev. d'Optique, 5. pp. 289–327, Aug., 1926.)—A fully illustrated paper describing in detail an absorption wedge precision pyrometer with filament extinction. The instrument can be readily modified to act as a microphotometer for very small sources. In the region of 2000° C. readings are true to about 1° C. A full discussion is given of a study of monochromatic glasses and the precision obtained in extrapolation to higher temperatures, means to obtain constant brilliance of the filament to about 1/200 and a bridge arrangement by which the brilliance of the filament is rendered quite independent of the temperature of the surroundings. W. H. GE.

166. *The Propagation of Flame in Mixtures of Methane and Air. Part IV. The Effect of Restrictions in the Path of the Flame.* **W. R. Chapman** and **R. V. Wheeler.** (Chem. Soc., J. pp. 2139–2147, Aug., 1926.)—Measurements are made of the propagation of flame in mixtures of methane and air along a tube containing restrictions in the form of brass annuli which are introduced at different points along it. Certain sections of the tubes are provided with a longitudinal window of quartz through which the movements of the flame can be photographed on a rapidly revolving film. In each instance the speed of the flame is retarded before the restriction is reached and enhanced after the restriction has been passed, while a secondary flame moves back rapidly. The greatest increase is produced when the restricting ring reduces the diameter of the tube by one-half. The intensity of the effects increases the further the restriction is removed from the point of ignition. By placing the restrictions closer together—*viz.*, 5 cm. apart—no appreciable retardation is observed, but a greatly enhanced speed results after passing each restriction. The highest speed of flame, 420 metres per sec., is obtained when twelve restrictions are present. The speed, once acquired, is maintained constant throughout the remainder of the tube. The actinic value of the flame is found to be much higher than that of the normal flame in methane-air mixtures. The acceleration of the speed of the flame produced by the restriction is attributed to an increase in the speed of the unburnt mixture which is in motion in advance of the flame front. [See Abstract 102 (1921).] J. N. P.

167. *Vapour Pressure of Ethane near the Normal Boiling Point.* **A. G. Loomis** and **J. E. Walters.** (Am. Chem. Soc., J. 48. pp. 2051–2055, Aug., 1926.)—A record of one of a series of investigations on the thermodynamic properties of the pure components of natural gas and of their binary mixtures. The vapour pressure of pure ethane has been measured from a pressure of 0·0245 to 2·1441 atmos. After a note on the preparation of the pure ethane experimental details are given. The temperature was maintained constant to 0·01° C., and the cryostat employed was that of Loomis and Walters. The results are given in tabular form, and the equation derived, representing P as a function of T, is:

$$\log_{10} P_{\text{atm.}} = -(780\cdot24/T) + 4\cdot2563 - 0\cdot000103T - 9\cdot3\times10^{-10}(T-238)^4.$$

The normal boiling point is calculated from the above as 184·467° K. The latent heat of vaporisation at the normal boiling point of ethane is calculated to be 3642·4 calories per mole. S. G. B.

168. *Vapour Pressures and Specific Volumes of the Saturated Vapour of Ethane.* **F. Porter.** (Am. Chem. Soc., J. 48. pp. 2055–2058, Aug., 1926.)—The specific volumes of the vapour have only been measured by Kuenen over a short range below the critical point. This paper extends the work of Kuenen and also of Loomis and Walters [see preceding Abstract] to the critical pressure. Tables showing the vapour pressures and specific volumes of the saturated vapour of ethane are given over the range from the normal boiling point to 288° K. The data were used to calculate the heats of vaporisation. An equation to represent the volumes was not found, but Dieterici's equation of state was the best approximation. Having Kuenen's data to evaluate the constants, the calculated values had a maximum deviation of 2·5 % and an average deviation of 1·3 % from the observed values. Practical details are outlined. S. G. B.

169. *High Vapour Pressures of Nitrogen.* **F. Porter** and **J. H. Perry.** (Am. Chem. Soc., J. 48. pp. 2059–2060, Aug., 1926.)—The authors have measured the vapour pressure of nitrogen over the range from 90·12° K. (3·631 atmos.) to 121·47° K. (26·75 atmos.). The platinum thermometer and cryostat previously used were employed and methane condensed from natural gas utilised for a bath liquid. The pressures were measured by a dead-weight gauge. The results, given in tabular form, are approximately represented by the equation $\log_{10} P = -302\cdot24/T + 3\cdot94127 - 0\cdot00274T + 1\cdot116 \times 10^{-6}(T - 100\cdot5)^3$. When extrapolated to low pressures this equation agrees tolerably with the data of v. Siemens. S. G. B.

170. *Vapour Pressure of Sulphur Monochloride.* **E. H. Harvey** and **H. A. Schuette.** (Am. Chem. Soc., J. 45. pp. 2065–2068, Aug., 1926.)—From 0° to its boiling point, over which range of temperature sulphur monochloride is a stable well-defined compound, its vapour pressure is represented by the equation, $\log P = 7\cdot4550 - 1880\cdot1 \div T$. The heat of vaporisation, calculated by means of the Clausius-Clapeyron equation, is 63·9 cals. per gramme, and the calculated molecular elevation of boiling point, 52·9, agrees with that found empirically by other observers. T. H. P.

171. *Survey of the Methods of Transmission of Heat.* **H. Gröber.** (Zeits. Vereines deutsch Ing. 70. pp. 1125–1128, Aug. 21, 1926.)—A report of a lecture giving a general survey of the facts known concerning conduction, radiation and convection of heat. S. G. B.

SOUND.

172. *Flow from Annular Nozzles.* **E. Tyler** and **E. G. Richardson.** (Phil. Mag. 2. pp. 436–447, Aug., 1926.)—Once started, the eddying motion of a fluid through the annular orifice between a disc and a tube is governed by the diameter of the disc and is influenced only slightly by the width of the orifice. It is, in fact, the Æolian tone phenomenon of a disc modified by the outer boundary of the nozzle. There is a critical velocity for the commencement of the eddying flow, and this is governed by the width of the orifice, but a little above this at another critical velocity the eddying is governed by the size of the disc. When the eddies strike a circular edge, the distance between successive vortices becomes equal to or a submultiple of the distance from the orifice to the edge. This is ascribed to secondary eddies produced at the edge itself. [See Abstract 718 (1923).] G. A. S.

173. *The Acoustics of Large Halls.* **A. H. Davis.** (Architects J. 63. pp. 565–568, 1926.)—Following a statement of the conditions for good hearing in an auditorium, the paper describes a ripple tank by means of which, utilising the analogy between water waves and sound waves [see Abstract 1876 (1926)], a study is made of the reflecting and focussing characteristics of model sections of an auditorium. An illustration is given of the similarity between ripple photographs and photographs of an actual sound pulse. The method of calculating the period of reverberation of a hall is outlined, and optimum and tolerable reverberant conditions are discussed. The paper concludes with an outline of the acoustical requirements when electrical speech amplifiers are used in large halls. Such equipment solves the question of adequate loudness, but it is not a cure for excessive reverberation. It may, however, reduce the disadvantage of a very high ceiling. AUTHOR.

174. *Designing for Loud Speakers.* **A. H. Davis.** (Architect, 116. pp. 371–372 and 399–400, 1926.)—The paper discusses the use of electrical speech amplifiers in large auditoriums and the acoustical design of assembly halls in which the equipment is likely to be used. For natural effect, amplification should not exceed the minimum necessary to enable remote listeners to hear with comfort, and the loud speakers should be placed several feet above the speaker's head. Such elevation of projectors tends to eliminate echo troubles arising from high ceilings, but low ceilings are indirectly advantageous in that they are inexpensive aids in restricting reverberation. The equipment itself is no cure for excessive reverberation; indeed, a highly reverberant hall results in a tendency of the apparatus to "sing." In general, upper parts of the room should be absorbent, possible echoes being suppressed and reverberation controlled. Galleries should not overhang so as to screen persons beneath them from sound emitted from the elevated projectors, and the region of the platform should be specially absorbent to reduce resonances, reverberation and general noises near the microphone. An accessible permanent housing for the speech projectors should be included in the design, and a small room set apart for electrical auxiliaries. AUTHOR.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

175. *Electrostatic Problems.* **Hertha Petersohn.** (Zeits. f. Physik, 38. 9–10. pp. 727–737, 1926.)—A purely theoretical paper dealing with two dimensional problems in electrostatics, the resulting fields and potentials being shown graphically for nine cases. W. H. Ge.

176. *Are Plants Electrified?* **G. Kainz.** (Phys. Zeits. 27. pp. 524–527, Aug. 1, 1926.)—Previous experiments to show the flow of electrical currents in plants are described, and further experiments to show a negative statical charge upon plants have been carried out by the author upon 200 different plants, when these were watered with ordinary rain and distilled water. This charge is attributed to the friction between the water drops and the microscopic ripples in the wax of the epidermal layer of the leaves, the plant attaining a negative and the water drops a positive charge. A charge is also due to the Lenard-effect, but this is very small and requires delicate instruments to demonstrate. Means are described by which plants not showing this charge effect are treated with wax dissolved in benzene and then show it equally with those having a waxy epidermis. It is remarkable that no plants of our planet show positive charge effects. Experiments are also described upon leaves containing oxalates and other salts. Mechanical pressure upon a leaf develops an electromotive force, and the method of demonstration is given. A double-layer theory of plant electrification is discussed. In spite of the plants acquiring negative and the raindrops equal positive charges by the above action, these charges are not neutralised in the earth, as part of the positive charge of the rain is lost to the air. The earth therefore acquires a continual negative charge, which is not only to be attributed to electronic emission of radioactivity, but also to plant electrification, and Lodge has shown that plant growth in Arctic regions is dependent upon electrical action. B. J. L.

177. *Curved Path of Wireless Waves.* **A. Mallock.** (Nature, 118. pp. 443–444, Sept. 25, 1926.)—A recent discussion on the electrical state of the upper air [see Abstract 2157 (1926)] really turned on the question as to why wireless waves follow the curvature of the earth instead of spreading into space, and the present writer now briefly discusses the various proposals. He points out that only one contributor to the discussion referred to refraction and diffraction as possible causes. If it were assumed that the speed of long waves is the same as that of ordinary light, and depends in the same way on the density of the air, then refraction would account for, roughly, one-tenth of the observed deflection. The author argues, however, that if it were found for wireless waves that the velocity increased about 1 part in 4000 per mile of height above the ground (the velocity of light is scarcely known to this degree of accuracy), the reason for such waves following the curvature of the earth would require no further explanation, and until experiment proves that there is no such change, it would be reasonable to impute the observed curvature of path to this kind of cause. The writer concludes his note with a description of a graphical construction for determining diffraction effects which is of very general application. H. H. Ho.

178. *Observations of Atmospherics in Western Africa.* **H. Hubert.** (Comptes Rendus, 183. pp. 368–370, Aug. 2, 1926.)—Atmospherics observed by means of an arrangement similar to that employed by Rothé and Lacoste [see Abstract 1064 (1923)] are classified as in the paper referred to. Discharges are directly related to thunderstorms and have a maximum frequency oriented towards the east. The range of maximum frequency is the same for all wave-lengths, but there is a maximum frequency between 6000 metres and 15,000 metres. In winter, discharges are only detected when storms exist within a radius of 400 kilometres, and audibility is greater when the storm approaches the observer. The other disturbances ("cracklings," "clappings") occur constantly and have a maximum with orientation to the east, there being no fixed range of greatest frequency. The observed frequency is greater during night-time, with a southerly displacement of the maximum, the former effect being ascribed to greater audibility by night. Such disturbances are considered to be due to non-luminous oscillatory discharges, at least several thousand metres in altitude, between masses of air of different potential approaching each other as a result of violent ascending currents. A. B. C. L.

DISCHARGE AND OSCILLATIONS.

179. *High-Frequency Oscillatory Discharge in Rarefied Gas.* **R. C. Richards.** (Phil. Mag. 2. pp. 508–511, Sept., 1926.)—A special discharge-tube was used with one fixed electrode and one which could be moved so as to give a longer or shorter discharge path. A simple valve generator, with 800 to 1000 volts in the anode circuit, was used to produce the high-frequency discharge in the tube, which was connected across the oscillatory circuit in the anode circuit of the valve. Photographs are given of the discharge under various conditions and different electrode distances. Both electrodes appear to be kathodes, having the usual negative glow and dark spaces, the positive column occupying the central region of the tube if the electrodes are far enough apart. When the pressure is adjusted to give striæ it is seen that the striations are double, and separating the electrodes only has the effect of increasing the number of double striations. It seems probable that of the double striæ one set belongs to the discharge in one direction through the tube and the other set to the discharge in the opposite direction. A. W.

180. *Auto-Electronic Discharge.* **K. Cunradi.** (Ann. d. Physik, 81. 2. pp. 155–172, Sept. 8, 1926.)—This research on the point discharge has given the following results: In general the current strength increases strongly with increasing tension. The discharge is favoured by the presence of an alkali. The more pointed the kathode the sooner the discharge takes place. If the kathode has several equal points, the necessary tension mounts to a higher value. A glow of the point does not promote the discharge, but hinders it. The giving out of electrons is probably dependent on the gas contained by the point. The inconstance of the discharge and the movement of the glow spot is caused by the several minute sub-points which make up the kathode point. A scintillation calls forth a sudden mounting of the current strength. The phenomenon is probably due to a glow of dust and oxide particles to be found on the antikathode. A. E. G.

181. *Lag with Spark Discharge.* **K. Zuber.** (Ann. d. Physik, 81. 3. pp. 205–228, Sept. 17, 1926.)—An arrangement is here described which allows the dependence of a on ΔV to be ascertained from a single distribution curve. The accuracy of the value so obtained is examined approximately. A formula is derived experimentally which serves for the calculation of a. A. E. G.

182. *Passage of Electrons through Small Apertures.* **G. F. Brett** and **R. Whiddington.** (Leeds Philosoph. and Lit. Soc., Proc. 1. pp. 65–69, Jan., 1926.)—It has been generally assumed that, in a perfectly evacuated space containing kathode and anode, electrons originating at the kathode will reach the anode with energy given by eV and pass through an aperture in the anode with this energy. A few of the typical results obtained using a copper slit are: In every case the electrons emerging on the far side of the slit, when deflected on to a photographic film, give a magnetic spectrum consisting of well-marked lines or bands. The bands in most cases are associated with a bad vacuum. The lines may be due to a peculiarity in the emulsion of the photographic film. There may be some definite energies of electrons falling on the film, which by ionisation or radiation among the atoms of the film produce blackening there. That this was not the case is proved by keeping the value of the deflecting magnetic field constant and varying V. The lines are merely shifted along the film, preserving their relative positions. The possibility of such an effect must be borne in mind, particularly at low electron energy. The lines may be produced as a result of radiation or ionisation losses on the primary electrons passing through an atmosphere surrounding the emitting surface. It is thought from experiments carried out on changing the distance between emitter and slit that this effect may in some cases be present. The lines may be produced as a result of "reflection" from the sides of the slit of those electrons which are directed towards it by the electric field, energy differences being thereby introduced equivalent to radiation and ionisation potentials. This explanation appears at present most likely to be fruitful, and further experiments are in progress. [See also Abstract 2338 (1925).] A. E. G.

183. *Temperature Relations of Photoelectric and Thermionic Emission of Electrons.* **E. H. Hall.** (Nat. Acad. Sci., Proc. 12. pp. 486–488, Aug., 1926.)—Following up theories previously put forward [Abstract 1934 (1921)], the author obtains an expression for the work done against resisting forces in removing an electron from the "free" state within a metal to the free state outside the metal. The expression indicates that the work should diminish with rise of temperature. The formula is shown to be not inconsistent with Richardson's emission equation. A. W.

184. *Photo-Ionisation Experiment with Hydrogen.* **F. L. Mohler.** (Nat. Acad. Sci., Proc. 12. pp. 494–496, Aug., 1926.)—A sensitive method of detecting photoelectric ionisation of a gas has been described by Foote and the author [Abstract 2747 (1925)]. Recently experiments have been carried out to see if there is any photo-ionisation of hydrogen by its own radiation. The results point to the conclusion that hydrogen does not emit radiation which is capable of ionising the normal molecule. Spectroscopic results seem to be consistent with this conclusion, for no hydrogen lines have been identified beyond 885 Å. corresponding to 15 volts. The bearing of this negative result on the structure of the hydrogen molecule ion is briefly discussed. A. W.

185. *Photoelectric Emission from Platinum as Influenced by Heating.* **L. A. Welo.** (Phil. Mag. 2. pp. 463–473, Aug., 1926.)—This paper is intended to be in the nature of a reply to a recent paper of K. Herrmann on "The influence of gas content on the photoelectric emission and the electrical conductivity of platinum." The results here given show that the ease with which platinum may be made relatively insensitive towards ultra-violet light is very markedly dependent on the sample of platinum employed. A foil is here employed which decreases in sensitiveness to about 1/12 of a previous maximum after having been heated to slightly more than 1400° C. Data are presented for another foil which decreased in sensitiveness to 1/37 of a previous maximum value on heating to only 1140° C. The possible influence of mercury vapour is also considered. Herrmann considers that a certain minimum which appears in a curve showing the photoelectric sensitiveness as a function of the heating current sent through the foil is due to the presence of mercury vapour. It is pointed out here that this minimum disappears as the heating is continued or if the temperature is raised, in spite of the continued presence of mercury vapour; also this minimum appears when somewhat similar experiments are performed in the open air and under conditions such that no mercury vapour can possibly be present. A few curves are included which show that the effect of adding gases after outgassing by heating is dependent on the particular sample of platinum in use. A. E. G.

186. *Transference of Energy in Collisions between Electrons and Molecules.* **J. S. Townsend** and **C. M. Focken.** (Phil. Mag. 2. pp. 474–495, Aug., 1926.)—After a very complete theoretical discussion of the subject, experiments are described the results of which, taken in conjunction with those of other experiments on the conductivity between parallel plates, lead to the following conclusions: A definite increase in current due to ionisation by collisions may be obtained in helium with potentials as low as 21 volts and in neon with potentials as low as 17 volts. These numbers are upper limits of the ionising potentials. The increase of current which may be attributed to a photoelectric effect of radiation from molecules of the gas is small compared with the increase of current due to ionisation by collision. A. E. G.

187. *Passage of Corpuscular Rays through Matter.* **A. Becker.** (Ann. d. Physik, 81. 1. pp. 91–108, Aug. 30, 1926.)—The experiments here described are carried out with kathode rays and α-rays. It is endeavoured to show how far the behaviour of matter towards moving atoms and electrons can be traced to a common mechanism. It is shown that, within the accuracy limits of the observations, there is almost complete accord in the principal phenomena in both regions of observation. Where discrepancies occur it is considered that they are chiefly due to differences of the mass of the ray carriers. The following are the main points dealt with: (*a*) Loss of velocity, (*b*) secondary rays, and (*c*) absorption. A. E. G.

188. *Townsend's Theory and the Penetration of Air at Shock Tensions.* **W. Rogowski.** (Archiv f. Elektrot. 16. pp. 496–508, Aug. 23, 1926.)—In this paper an attempt is made to explain all the penetration phenomena which have been observed by reference to Townsend's theory. The paper is well illustrated by graphs showing results obtained by various observers. The following are among the main points considered: The rupture and Townsend's theory; velocity of electrons and positive ions.
A. E. G.

189. *Emission of Electrons and Positive Ions at the Melting Point of Metals.* **A. Wehnelt** and **S. Seiliger.** (Zeits. f. Physik, 38. 6–7. pp. 443–464, 1926.)—Apparatus is described specially designed for the accurate measurement of the emission of electrons and positive ions from metals in the neighbourhood of the melting point, and experimental results for copper and silver are given. The emission curves for these two metals exhibit kinks at the melting point which show that the emission work of the molten metals is less than that for the solid state. The number of free electrons is found to be reduced in passing to the fluid state approximately in the same ratio as the resistances of the conductors are increased. [See Abstract 832 (1926).] A. W.

190. *Kathode Scattering.* **A. v. Hippel.** (Ann. d. Physik, 80. 7. pp. 672–706, July 29, 1926.)—This paper contains an account of an experimental investigation of the nature and charge of the metallic particles emitted at the kathode. These particles are found primarily to consist of a very large percentage of uncharged atoms, an experimental proof of which is given by a new method of spectroscopic vapour-pressure measurements combined with vapour-pressure measurements from the emission densities. The utility of the spectroscopic method, the applications of which are not confined to the current problem, depends on the observation of a series of optical conditions which are very thoroughly discussed. Experimental arrangements are described in great detail with numerous plates and diagrams. For the eruptive experiments cadmium was the principal metal studied, the results being supplemented by measurements with zinc and silver. A special new absorption effect has been observed during the scattering of cadmium. Previous work on the subject is also reviewed [see Abstract 2165 (1926)] and a bibliography included. H. H. Ho.

191. *Scattering of Electrons in Helium.* **E. G. Dymond.** (Nature, 118. pp. 336–337, Sept. 4, 1926.)—The energetic relationships in collisions between electrons and gas molecules are well known, but the angular relationships of the electron and molecular paths are unknown. Ramsauer, Davisson and Kunsman, and Langmuir have obtained unexpected results, and Elsasser has put forward an explanation in terms of de Broglie's "phase wave." The author has investigated the scattering of a thin beam of electrons in helium at 0·03 mm. pressure. Results for the scattering of electrons having suffered inelastic collision and lost 20 volts energy are given for initial velocities of 100 and 400 volts respectively. For $V_i = 100$ volts two maxima are observed, one at 5° to the initial direction of propagation and a broader one at 60°. For $V_i = 50$ the principal maximum broadens and moves to 20°. At higher velocities this maximum moves to smaller angles and for $V_i = 200$ is at less than

2·5°. At higher velocities a third maximum appears at 30° and is much sharper than the other two. For $V_i = 400$ the electrons losing no energy is similar to that for 100-volt electrons which have lost 20 volts. The occurrence of these maxima suggests interference as suggested by Elsasser, but the 30° sharp maximum is independent of velocity, in opposition to this theory. **W. V. M.**

192. *Influence of Chlorine on the Mobility of Ions in Pure Oxygen.* **H. Mayer.** (Phys. Zeits. 27. pp. 513–518, Aug. 1, 1926.)—The mobility of positive and negative ions in pure dry oxygen is determined by means of the Franck-Pohl modification of the Rutherford alternating field method with an alternating field of square wave-form. The influence which an increasing mixture of chlorine exercises on these mobilities is determined. It is found that a small admixture of chlorine lowers the mobility of the negative ions considerably, but has no marked influence on that of the positive ions. A determination of the ratio of these two mobilities in pure chlorine at a pressure of 80 mm. Hg is made. The results obtained are explained in the sense of a cluster-theory. Further work is in progress. **A. E. G.**

193. *Mean Free Path of Electrons in Mercury Vapour.* **L. R. Maxwell.** (Nat. Acad. Sci., Proc. 12. pp. 509–514, Aug., 1926.)—For a beam of electrons moving through a gas, $I = I_0e^{-x/\lambda}$, where I_0 is the initial number of electrons in the beam, I the number which traverse a distance x without suffering a collision with a molecule of the gas, and λ is the mean free path. In order to apply this equation experimentally it is sufficient to insert a movable Faraday cage which can measure the current I_0 and then the succeeding values of I. In doing this the natural spreading of the beam must be considered. If, when there is no gas in the presence of the electrons, K is the fractional part of the total number of electrons initially present in the beam which enter the cage opening for a certain position x, the equation assumes the working form $I = KI_0e^{-x/\lambda}$. The value of K being found for a value of x with the gas absent, and the value of $\frac{I}{I_0}$ being found for the same x with the gas present, λ may be calculated. Determined by this means, the mean free path of slow electrons in mercury vapour over the range 0·5 to 3000 volts is found to increase with the accelerating potential, the curve showing changes of direction at 4·9 and 6·7 volts and a slight minimum at 40 volts.

T. H. P.

194. *Thermionic and Adsorption Characteristics of Cæsium on Tungsten and Oxidised Tungsten.* **J. A. Becker.** (Phys. Rev. 28. pp. 341–361, Aug., 1926.)—This paper describes a new method for determining quantitatively how the concentration of adsorbed atoms is affected by surface temperature, surface potential gradient, and rate of arrival of atoms. The study of cæsium adsorbed on tungsten leads to the following conclusions. The first few cæsium atoms that strike a clean tungsten surface are ionised. If the filament temperature is above a critical value, Tc_2, and the plate is sufficiently negative, every atom that strikes the filament comes off as an ion and it stays practically clean. If the temperature equals or is less than a lower critical value Tc_1, a few of the striking atoms fail to evaporate, but are absorbed on the tungsten surface as ions. The strong local fields produced by these ions increase the work function for positive ions, so that a smaller percentage of the atoms that strike come off. Soon every atom that strikes sticks. When θ, the fraction of the surface covered with the cæsium, reaches a certain value, as much cæsium evaporates as strikes. By now the adsorbed cæsium can no longer all be ionised, and the particles that come off are nearly all atoms and not ions. If the temperature is lowered, more atoms stick until a new equilibrium θ is reached. If the plate is positive during adsorption, every atom that strikes the filament sticks until the equilibrium θ is reached. The shape of the curves which give the relation between rate of evaporation of cæsium and θ satisfactorily accounts for the observed critical temperatures and hysteresis effects for positive ions. These curves also explain why the filament cleans itself spontaneously when we approach the higher of these critical temperatures and why this process is accompanied by a momentary rush of positive ions from the filament. The adsorbed cæsium greatly modifies ϕ_e, the work function for electrons. For clean tungsten this has the value 4·52 volts. As θ increases, ϕ_e decreases rapidly at first, then progressively less rapidly. When $\theta = 1{\cdot}00$, ϕ has a minimum value of 1·36 volts. When the second layer is formed, ϕ_e increases again. The results obtained are compared with those of Langmuir and Kingdon. A. E. G.

195. *Secondary Electron Emission from Tungsten, Copper and Gold.* **R. L. Petry.** (Phys. Rev. 28. pp. 362–366, Aug., 1926.)—By a null method of high precision, previously described [see Abstract 154 (1926)], the secondary electron emission from tungsten, copper and gold surfaces bombarded by an electron stream has been measured and the ratio I_1/I_2 of secondary current to primary current plotted as a function of the velocity of the primary electrons. The maximum values reached by the ratio I_1/I_2 were as follows: 1·45 for tungsten at 700 volts, 1·32 for copper at 240 volts, 1·14 for gold at 330 volts. Tungsten showed fairly satisfactory critical potentials at 11·0, 17·1, 25·2, 29·3, 40·5, 46·0, 89·5, and 271·5 volts. Copper showed breaks at 7·8, 12·6, 16·8, 19·5, 23·8, 39·0, 56·9 and 73·5 volts, the first two being marked by very definite minima. Gold indicated critical potentials at 15·5, 21·0, 23·2, 31·5 and 43·7 volts. Comparison of these potentials with soft X-ray levels does not lead to a definite conclusion as to the relation between the two. AUTHOR.

196. *Transmission of Low-Velocity Electrons through Thin Metallic Foils.* **T. Kurtchatov** and **K. Sinelnikov.** (Phys. Rev. 28. pp. 367–371, Aug., 1926.)—In a recent paper Hartig [see Abstract 2750 (1925)] showed that electrons having a velocity ranging from 2 volts upward can be transmitted through aluminium foils of a thickness of 3 and even 9μ. Hartig tested his foils for holes in transmitted light. It is here shown that (1) foils showing no holes in transmitted light may show holes when tested with water. (2) Whereas Hartig's results can be confirmed with foils tested only in transmitted light, they are not confirmed in foils showing no holes in water. No electrons are transmitted in this case. (3) Hartig's results can be produced artificially by making holes in foils. Manifold reflections of electrons considered in the light of the experiments of Bayer, Hull, Lukirsky and Semenoff are given as an explanation of Hartig's results. AUTHORS.

197. *Mobility of Acetylene Ions in Air.* **H. A. Erikson.** (Phys. Rev. 28. pp. 372–377, Aug., 1926.)—The mobilities in air of the positive and negative ions produced in acetylene by means of the alpha-rays from polonium have been measured by means of a blast method. It is found that in acetylene, as in air, carbon dioxide, hydrogen and argon, only one negative ion is formed. This ion has the same mobility in air as have the negative ions formed in the other gases referred to. On the other hand, the positive ion formed in acetylene differs from those formed in the other gases in that it does not, at least up to an age of one second, change over into a more stable ion of smaller mobility. The positive ion of acetylene has a mobility slightly less than that of the negative ion, and in this respect resembles the initial positive ion of hydrogen. The initial positive ions in air, carbon dioxide and argon have the same mobility as have the negative ions of these gases. It is also found that a neutral acetylene molecule is able to take up the charge of the final positive ion formed in air and in nitrogen. The resulting positive ion has the same mobility in air as the normal positive acetylene ion. This indicates that the process is of the nature of an electron interchange rather than a chemical oxidation effect. AUTHOR.

198. *Direct-Reading Ionisation Gauge.* **C. G. Found** and **N. B. Reynolds.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 217–222, Aug., 1926.)—In a previous paper [see Abstract 2317 (1924)] Dushman and one of the authors described the operation and calibration of a three-electrode tube as an ionisation gauge for pressure measurements. Its operation is dependent on the fact that the positive ionisation is proportional to the pressure of the gas in the tube when the electron current and accelerating voltage are maintained constant. Later it was thought desirable to have a gauge simpler in construction and easier in manufacture. The greatest simplification in manufacture is obtained by mounting all the electrodes on a single stem similar to the construction of small radio receiving tubes. Various types of radio receiving tubes are therefore tested as ionisation gauges. In using the new tube as a gauge, the general practice is to use the grid as anode or accelerating electrode with an accelerating potential of 125 volts. The plate is used as a collector at a voltage of about 22 volts negative with respect to the negative end of the filament. The electron current is controlled by variation of the kathode temperature. A diagram showing connections for a direct-reading ionisation gauge is given, as is also a description of the amplifier and of the protection for the gauge. A. E. G.

199. *Spark Resistance and Surge Wave-Fronts.* **O. Mayr.** (Archiv f. Elektrot. 17. pp. 52–60, Sept. 8, 1926.)—The importance of Toepler's formula for spark resistance in the theory of surge phenomena renders it desirable to extend the experimental basis of the formula. In this connection various old and new experimental arrangements are discussed theoretically and experimental results are given for two methods of investigation, the discharge of a condenser (1) across a spark gap with an ohmic resistance, and (2) with a very long conductor. Toepler's resistance law was found to be established, but a larger correction factor was obtained. This is discussed with reference to Toepler's measurements. The calculation of the shape of surge wave-fronts by means of Toepler's formula is generalised by taking account of the wave resistance of the conductor.

It is shown that the form of the surge wave-front is almost independent of the magnitude of the wave resistance and the adjustment of the spark-gap electrodes. [See also Abstract 1470 (1925).] A. W.

200. *Spark Constant.* **M. Toepler.** (Archiv f. Elektrot. 17. pp. 61–70, Sept. 8, 1926.)—A new method for determining the spark constant is described. The arrangement is symmetrical, the spark-gap terminals being connected to the inner coatings of two condensers whose outer coatings are joined by an ohmic resistance. All connections are made as short as possible so that they can be regarded as resistanceless and without induction. The theory of the method is given fully and also tables of experimental results. The mean value found for the spark constant is $0{\cdot}450 \times 10^{-8}$. [See Abstract 1470 (1925).] A. W.

201. *Relation between the Height of the Heaviside Layer and High-Frequency Radio Transmission Phenomena.* **A. H. Taylor.** (Inst. Radio Eng., Proc. 14. pp. 521–540, Aug., 1926.)—The theoretical basis of this paper has previously been given [see Abstract 1438 (1926)]. The present discussion is concerned solely with waves short enough to show the " skip distance " effect, and one of its main interests lies in the indication that it may give as to the possible lower limit of wave-length which will be useful in long-distance communication. It was shown in the earlier paper that, for a layer of height 150 miles, the shortest wave it would be possible to use in long-distance communication would be 14 metres. Extensive experiments have not brought forth any evidence contradicting this conclusion, but inasmuch as the Heaviside layer during the middle of the day is lower than at other times, and lower in summer than in winter, the investigations have been extended to waves between 11 and 20 metres during the middle of the day. The results have shown good agreement with earlier work and permit to a certain extent the forecasting of probable results to be obtained at various wave-lengths, provided they are short enough to show skip distance effects. It would appear that long-distance communication is not possible below 11·5 metres for a 100-mile layer, 14 metres for a 150-mile layer, 16·5 metres for a 225-mile layer, 19 metres for a 300-mile layer, and 25 metres for a 500-mile layer, which is approximately the height often existing during the middle of the night in mid-winter. A. W.

202. *" Kippschwingungen " in Electron Tubes.* **E. Friedländer.** (Archiv f. Elektrot. 17. pp. 1–16, Sept. 8, 1926.)—In this paper it is shown under what conditions a reinforced tube is in a position not only to maintain oscillations of its own proper frequency, but also to generate another kind of periodic occurrence which has been observed in other circumstances and has been called " kippschwingungen." After stating the problem to be considered, the following are among the points dealt with: Regulation of the phenomena in the system of the alternating-current generator; survey of the known " kippschwingungen " phenomena; general stability considerations; the $\lambda_{(k)}$-diagram for " kippschwingungen "; the arc light condenser oscillation. [See also Abstract 2179 (1926).] A. E. G.

203. *Calculation of the Radiation Field.* **F. Kiebitz.** (Ann. d. Physik, 80. 7. pp. 728–740, July 29, 1926.)—The case here considered is that of a rotationally symmetrical field, for which a solution of Maxwell's equations is obtained, using cylindrical coordinates, in a form which can be called a generalisation of the Hertz solution, since it has a wider application than the Hertz solution to the case of a sphere of infinitely large radius. A. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

204. *Electric Conductivity of Liquid Cyanogen Bromide.* **G. Glockler.** (Nat. Acad. Sci., Proc. 12. pp. 522–523, Aug., 1926.)—According to Grimm's views on pseudo-atoms [Abstract 35 (1926)], which is supported by Mulliken's theory of band-spectra [Abstract 736 (1926)], the cyanogen radicle should be like the sodium atom, and its fused salts should conduct electricity. The cyanogen bromide of the author melted at 52° C. and at 55° C. had a specific conductance approximately of 0·02 mho per cm.^{3}. The electrolysis with platinum electrodes of the yellowish-brown melt yielded colourless gas at the kathode, which was not affected; the anode turned red. H. B.

205. *Electric Conductivity in Solid Dielectrics with High Field Intensities.* **H. Schiller.** (Ann. d. Physik, 81. 1. pp. 32–90, Aug. 30, 1926.)—Continuing previous investigations [see Abstract 1108 (1926)], this paper deals chiefly with the electrolytic conductivity of mica and gypsum and establishes the following results: (1) With high mean field intensities various kinds of glass, mica and gypsum showed a marked increase of apparent conductivity with growing tension. The dependence of conductivity on mean field intensity may be well represented for an intensity interval of 10^6 volts/cm. by Poole's ratio $\Lambda = \Lambda_0 e^{\beta x}$. The constant Λ_0 is independent of the thickness of the material and the constant β only slightly affected by it. The relation of conductivity to temperature follows the same laws with high as with low field intensities. (2) Electromotive counter-forces of some thousands of volts are observed in glass and explained by the occurrence of space charges at the electrodes. (3) The conductivity of mica is notably influenced by radioactive irradiation. A distinct ionising effect of α-rays was observed, an α-ray of RaC producing in a field of $1{\cdot}5$–$1{\cdot}7 \times 10^6$ volts/cm. from 16 to 80 ion couples. (4) Various explanations of the increase in conductivity are discussed, and it is pointed out that considerable light may be thrown on the question by testing Faraday's law with high field intensities. (5) The possible influence of the formation of space charges and intensifying the field at the electrodes on dielectric anomalies and dielectric solidity is discussed. Details of results are given in numerous tables and figures. E. F.

206. *Deduction from Cardani's Formula.* **S. Timpanaro.** (N. Cimento, 3. pp. 267–269, June, 1926.)—Cardani demonstrated experimentally [see Abstract 1839 (1900)] that the law according to which the heat evolved in any section of the discharge circuit of a condenser varies when the resistance of the circuit is modified by an electrolyte may be expressed by the formula $N_0 - N/N = R/A$, N_0 being the number of divisions into which the petroleum meniscus of a Cardani thermometer inserted in the circuit breaks up when the electrolyte is excluded from the circuit, N the number of divisions obtained when an electrolyte of resistance R, not sensibly modifying the auto-induction of the circuit, is included in it, and A a constant depending on the explosive distance, capacity of the condenser, auto-induction and resistance of the circuit. The formula may be demonstrated theoretically on the basis of the fact that if the resistance of the circuit be varied while the quantity of the discharge and the initial potential—that is to say, the total available energy—is kept constant, then the amount of heat evolved will also remain unaltered. Treating the problem mathematically, the author's deduction shows that the constant A is the reduced resistance of the circuit when the electrolyte is excluded from it. E. F.

207. *Influence of Mechanical Processes on the Electrical Resistance of Some Alloys of Nickel and Iron.* **A. de Negri.** (N. Cimento, 3. pp. 270–280, June, 1926.)—Extension of previous researches [see Abstract 164 (1926)] to alloys of Ni and Fe containing respectively 22, 36, 44, and 49 % of Ni. The material was employed in wires of 0·5 mm. in diameter and about 1 m. in length. The chief interest lay in determining whether successive annealings had any effect on the electrical resistance apart from the structural conditions determined by various mechanical processes. The results, set out in great detail in several tables, may be thus summarised: (1) For unilateral thermal cycles the 36, 44 and 49 % alloys present perfectly reversible variations of resistance. (2) For temperatures rising to 500° the non-oxydised 22 % alloy shows greater variations than for falling temperatures. (3) The thermally reversible, permanently deformed alloys are subject to the effect of the first annealing. (4) Stretching and wire-drawing produce at equal temperatures a diminution of the ratio $(R_t - R_0)/R_0$ compared with that of the normal alloy, such diminution being in direct ratio to the deformation. (5) The derivation method applied to the alloys examined reveals peculiarities which are of a similar nature in two separate pieces of the same sample. E. F.

208. *Interpretation of Deviations from Ohm's Law.* **K. T. Compton.** (Nat. Acad. Sci., Proc. 12. pp. 548–551, Sept., 1926.)—The deviations of a few per cent. from Ohm's law found by Bridgman when gold and silver films were traversed by currents of several million amperes per cm.^{2} are discussed in connection with Thomson's Second (or Doublet) theory of metallic conduction and also with the classical free electron theory. It is shown that the experimental data disprove the doublet theory but are consistent with the free electron theory. F. S.

209. *Anomalous Dispersion and Absorption of Electric Waves. Part V.* **S. Mizushima.** (Chem. Soc. Japan, Bull. 1. pp. 163–168, Aug., 1926. In English.)—Using waves of 3·08 and 50 metres measurements of dielectric constants and absorptions were made as in previous work [see Abstracts 2941 and 2942 (1926)] for various alcohols and for glycerine. The results as regards temperature variation were in general similar to those for 9·5-metre waves. It appears that the dielectric constants of alcohols and glycerine change continuously from the large value for the static field to the small value nearly equal to the square of the refractive index, and the region of anomalous dispersion accompanying intense absorption shifts to longer wave-lengths as the temperature is lowered. The results for the alcohols are in general agreement with Debye's dipole theory, but Debye's formula does not appear to hold for glycerine. A. W.

210. *Dielectric Constant of Diatomic Dipole-Gases on the New Quantum Mechanics.* **R. de L. Kronig.** (Nat. Acad. Sci., Proc. 12. pp. 488–493, Aug., 1926.)—Pauli [Abstract 969 (1922)] has given a treatment of the dielectric constant of diatomic dipole-gases based on the classical quantum theory of multiply periodic systems. It is here shown that the problem can be successfully treated by the methods of Heisenberg's quantum mechanics [Abstract 45 (1926)], and a complete solution can be given, since frequencies and amplitudes in the case of a rotator capable of orientation in space are now known. The results obtained are checked by application to various particular cases. A. W.

211. *Dielectric Constants of Dipole Gases from Quantum Mechanics.* **L. Mensing** and **W. Pauli, Jr.** (Phys. Zeits. 27. pp. 509–512, Aug. 1, 1926.)—Works out the relation between the dielectric constant, the electric dipole movement of the molecules, and the number of molecules in unit volume, using the new quantum mechanics and Schrödinger's method of matrices, and finds that for high temperatures a formula results which is identical with that obtained for all temperatures by Debye using classical statistics. A constant C which is 1/3 in this formula varies from this value according to the new theory at low temperatures, but approximate calculations have shown that this variation is not more than 3 % in the temperature region which is of practical importance in the case of Zahn's measurements of the dielectric constants of the halogen compounds of hydrogen. According to the older form of the quantum theory, C differs considerably from 1/3 even in the limiting case of high temperatures.

H. N. A.

ALTERNATING CURRENTS AND MAGNETISM.

212. *Simple Compensation Apparatus for the Measurement of Mutual Inductance.* **W. Geyger.** (Archiv f. Elektrot. 17. pp. 71–78, Sept. 8, 1926.)—In this paper four simple experimental arrangements are described for the measurement of mutual inductance. These are based on the compensation method of Campbell, which involves a comparison of two mutual inductances arranged in series. In place, however, of a variator, an invariable normal air transformer is employed, whose secondary circuit contains a compensation resistance. The principles of measurement are given in detail with illustrative diagrams. The method gives direct readings, and many other technical advantages are claimed. Suitable modifications for different alternating currents are included.

H. H. Ho.

213. *Magnetic Saturation as a Means of Producing High-Frequency Oscillations.* **E. A. Guillemin.** (Archiv f. Elektrot. 17. pp. 17–52, Sept. 8, 1926.)—The arrangement studied by the author consists of two circuits magnetically coupled, the core of the coupling transformer becoming strongly saturated in normal working during a considerable portion of each half-period of the primary current. The primary or low-frequency circuit consists of a source of low-frequency e.m.f. in series with an inductance, a resistance, a condenser and the primary of the transformer; the value of the inductance is high in comparison with that of the primary winding on the transformer, and the capacity is chosen so as to satisfy the condition of resonance. The secondary circuit consists of the secondary winding on the transformer in series with an inductance, a resistance and a capacity. In order to render the problem amenable to mathematical treatment, the author assumes (1) that the magnetisation curve consists of two straight-line portions, thus: ┌; and (2) that during the interval in the neighbourhood of zero value of the primary current when the core remains unsaturated, the time-current curve is rectilinear. On the basis of these assumptions, the secondary induced e.m.f. consists of a series of (alternately positive and negative) rectangles (the base of each rectangle representing the time during which the core is unsaturated) separated by spaces (saturation interval) during which the induced e.m.f. remains zero. A comparison of the theoretical results obtained on the basis of these assumptions with some experimental work carried out by H. Plendl, F. Sammer and J. Zenneck shows that the theory gives a correct account of the behaviour of the circuits. A. H.

214. *Large Electromagnetic Disturbances in the First Four Months of 1926—Records of the Observatory at l'Èbre Tortosa (Spain).* **I. Puig.** (Comptes Rendus, 182. pp. 1482–1483, June 14, 1926.)—Remarks on the magnetic storms observed Jan.–April, 1926. Data are given relative to the sudden variations of declination (D), horizontal (H) and vertical (Z) components of the earth's field on four occasions when the disturbances were unusually strong (Feb. 17, Feb. 23–24, March 5–6, April 14–17). A. B. W.

215. *Records of the Survey of India.* (Survey of India, Records, 19. [121 pp.]. Received Oct. 25, 1926.)—Includes magnetic surveys, etc. For previous report see Abstract 1742 (1925).

216. *Magnetic Susceptibilities and Dielectric Constants in the New Quantum Mechanics.* **J. H. van Vleck.** (Nature, 118. pp. 226–227, Aug. 14, 1926.)—Magnetic susceptibility and dielectric constant are discussed with reference to the quantum dynamics developed by Born, Heisenberg and Jordan [see Abstract 1229 (1926)]. It is shown that the spatial quantisation relative to the applied field has no direct effect on these two quantities. The dielectric constant for a diatomic gas is calculated and an expression obtained which reduces to that of Langevin at high temperatures, in which respect it is superior to the expressions of Pauli and Pauling obtained from the older quantum theory. F. S.

217. *Permanent Magnetic Fields.* **O. Löbl.** (Archiv f. Elektrot. 16. pp. 395–437, Aug. 23, 1926.)—An experimental vindication of the Heaviside-Cohn equation. The connection between eddy-free continuous magnetic field strength and continuous induction in permanent magnets is investigated, and the conditions set out in the form of an equation. This new equation follows a criticism of the work of previous authors, and is shown to represent a linear law. Earlier experimenters have not considered the decisive part played by the spreading of the field. The configuration of the field was experimentally determined and elucidated both mathematically and graphically. The energy of a permanent magnet, if calculated according to a Poynting Vector, necessitates the employment of an additive constant. This constant is herein determined. The paper contains a full survey of the question under discussion and a complete bibliography. S. G. B.

218. *Permanent Magnetic Fields.* **E. Kurz.** (Archiv f. Elektrot. 16. pp. 438–480, Aug. 25, 1926.)—The equation for the characteristics of permanent magnets is shown, from the arguments of Löbl and others, to be valid and of the form $B = \mu(H^e + H)$, which agrees with the Heaviside-Cohn conditions. The relation of the extent and form of the magnetic field to the thickness of the magnet is deduced. The values of permeability and magnetising force for good chrome steel are determined and given as $H^e \cong 170\text{–}200$ and $\mu \cong 25\text{–}40$, and from these values the validity of the equation above is tested. The field distribution and relations for constant magnet winding were considered and the distribution set out, a simple form being shown as $\nu = a\left(1 - \frac{\delta}{\delta_0}\right)\frac{U}{q}$. The relationship between remanence and coercive force, with the constants of the characteristic equation for permanent magnets, is discussed. The paper is profusely illustrated by tables and curves. S. G. B.

219. *Permanent Magnetic Fields.* **H. Laub.** (Archiv f. Elektrot. 16. pp. 481–495, Aug. 25, 1926.)—The small deviations from the Heaviside-Cohn equation are explained by the inhomogeneity of the vector field H^e. The scalar equation $B = \mu(H^e - H)$ is shown to be a close approximation to actual fact for high-value steel. The Löbl method is used in the present work to explain the effects of cyclic and systematic alteration of the conditions of permanent magnets. In this case it is shown that no simple function $B = f(H)$ exists, but for increasing or decreasing field strength (H) the curve falls along two branches of a hysteresis curve. Experimental results are employed to show the relationship between μ and H^e and their dependence on the magnetisation. The paper concludes with a consideration of the influence and effect of currents on a stable permanent magnetic system, and comparisons of the resulting conditions with corresponding electromagnetic curve. A final note is given on the equivalent conditions of stability. S. G. B.

220. *Magnetic Stability of Permanent Magnets.* **R. C. Gray.** (Phil. Mag. 2. pp. 521–529, Sept., 1926.)—A distinction is made between the stabilisation of the *material* intended for permanent magnets, and the stabilisation of its *magnetism*. After the material has been mechanically stabilised, it should be magnetised to saturation and then demagnetised by an alternating decreasing field whose maximum value is slightly above that of the field likely to be experienced when the magnet is in use. A method of finding the value of this latter field is given. This partial demagnetisation stabilises the magnet not only against demagnetising fields, but also against temperature variations and against moderate vibration. The importance of a high coercive force is indicated. The percentage loss of magnetism with time is, approximately, inversely proportional to the coercive force. AUTHOR.

221. *Atomic Moments of Ferromagnetics.* **E. C. Stoner.** (Leeds Philosoph. and Lit. Soc., Proc. 1. pp. 55–64, Jan., 1926.)—An estimate of atomic moments is obtained from the variation in susceptibility with temperature above the Curie point and from the saturation intensity of magnetisation at low temperatures. The moments so deduced differ widely from each other and from those for ions in salts and solutions. These differences can be accounted for on the basis of the quantum theory of atomic magnetism without assuming a change in the constitution of the substance. It is supposed that there are groups of atoms in the crystals among which transfer and sharing of electrons may take place, and that the magnetic properties are due to ions with the same moments as those of ions in salts and solutions. [See Abstracts 2436 (1924) and 1979 (1925).] G. E. A.

222. *Fundamental Laws of Magnetic Viscosity.* **C. Lapp.** (J. de Physique et le Radium, 7. pp. 230–239, Aug., 1926.)—Continuing previous work [Abstracts 1294 (1924) and 2612 (1925)], the viscosity is found to vary with the amplitude λ of the cycle, the time t, and a quantity a called the rapidity. Logarithmic curves give, by extrapolation at the origin, the values of λ and of a. For fields approximating to the coercive field H_c, the logarithmic curve of viscosity becomes straight, and curves of this kind, drawn for three different rings, furnish the law that the variation of rapidity from its value in the coercive field is proportional to the square of the max. induction. From experiments with one ring of which the section is successively diminished, it is found that the amplitude calculated for unit section is constant, and that the rapidity is proportional to the inverse square of the section of the ring. G. E. A.

223. *Initial Magnetic Permeability.* **W. Vogel.** (Phys. Zeits. 27. pp. 544–554, Aug. 15, 1926.)—A useful collation of the researches on initial permeability (I.P.) from Rayleigh's first observation of it in 1887. The paper deals with its measurement and its occurrence in iron and iron alloys. Commercial qualities of iron have I.P. ranging from 50 to 500, whilst in permalloy I.P. attains a value of 12,000. Little is known of the I.P. of nickel, cobalt or Heusler alloy. In practice I.P. is of great importance in the magnetic material used in the manufacture of relays and recording apparatus for the purpose of extending the range of telegraphic transmission, and Heaviside's results have been applied to telephone and cable circuits by Pupin [see Abstract 656 (1903)] and Krarup [see Abstract 1958 (1902)] for this purpose. The significance of I.P. in preventing wave distortion and thereby increasing the speed of telegraphic transmission is discussed in connection with the use of compressed iron powder with an I.P. of 20 to 30 [see Abstract 874B (1921)]. G. E. A.

224. *Thermomagnetic and Galvanomagnetic Effects in Arsenic.* **N. C. Little.** (Phys. Rev. 28. pp. 418–422, Aug., 1926.)—Owing to the large value of the Hall and allied effects in Bi and Sb an investigation of these effects in As was made this element having further interest in that its chemical properties place it in the borderland region between metals and non-metals. For a small plate of the metal at 20° C. the following coefficients expressed in e.m.u. were found: Specific resistance, $4 \cdot 6 \times 10^4$; thermal conductivity, $3 \cdot 68 \times 10^6$; Peltier coefficient against Pb, $3 \cdot 80 \times 10^5$; Thomson coefficient, $3 \cdot 33 \times 10^3$; Hall coefficient, $4 \cdot 52 \times 10^{-2}$; Nernst coefficient, $2 \cdot 25 \times 10^{-3}$; Ettinghausen coefficient, $1 \cdot 75 \times 10^{-7}$; and Righi-Leduc coefficient, $4 \cdot 15 \times 10^{-7}$. Between 0° and 170° C. the temperature coefficient of resistance is 0·00435 and the thermal e.m.f. against Cu is $+ (7 \cdot 91t + 0 \cdot 051t^2) \times 10^{-6}$ volts. None of these coefficients shows variation with magnetic field strength. Thermodynamic relations between different effects are checked as to order of magnitude, but the difference between observed and computed values often differs by a factor of two. The thermomagnetic and galvanomagnetic effects of As, Sb and Bi show increase with atomic number;

the thermal conductivity decreases. Although the effects in As are smaller than in Sb and Bi, they are much more marked than in other metals with the exception of Te, Si and graphite. The thermal and electrical conductivity of As deviates markedly from the Wiedemann-Franz ratio, probably because of its non-metallic properties. When a longitudinal temperature gradient of 10° C./cm. existed in the plate, a field of 8000 gauss caused a drop in temperature of 0·4° C. This temperature change is proportional to the square of both temperature gradient and field strength. R. S. R.

225. *Attraction between Magnetised Surfaces.* **T. Lehmann.** (Rev. Gén. d'Él. 20. pp. 433–442, Sept. 25, 1926.)—The author arrives at an expression for the attraction between two magnetised surfaces by making use of the principle that the virtual reversible energy change per unit volume for any ferromagnetic substance is proportional to the scalar product of the field intensity and increment of induction [see also Abstract 1213 (1925)]. A. H.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

226. *A Choke Coil for Controlling Filament Currents in X-Ray Tubes.* **A. E. Kunberger** and **C. E. Lanyon.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 243–244, Aug., 1926.)—The disadvantages of resistance control of the filament current of a Coolidge tube as regards wear of the resistance studs are pointed out. A choke coil to obtain a continuous control without such disadvantages is illustrated, and constructional details are given. B. J. L.

227. *Vacuum Tubes of Quartz and of Mercury Vapour.* **H. Bordier.** (Arch. d'Él. Médicale, 34. pp. 346–349, Aug.-Sept., 1926.)—The use of the gaseous vacuum tube in therapeutic work, originally due to MacIntyre, has been long known. These tubes, employed to give electrostatic effects (electric effleuve), do not give rise to ultra-violet radiation, although often termed "violet-ray" apparatus, because of the violet colour of the gaseous discharge. R. Gallois has produced similar tubes, filled with an inert gas, but also containing mercury. The mercury forming an arc can give rise to true ultra-violet radiation. In the usual types of such discharge tubes the glass would itself absorb the ultra-violet radiation, and, to prevent this, these new tubes are made of quartz. Such tubes give evidence of ultra-violet radiation by all the well-known phenomena, *i.e.*, ionisation, discharge effects, action upon barium platino-cyanide, etc. Illustrations of tests upon glass and quartz tubes are shown in which the former show no ultra-violet radiation, whilst the latter show the emission of such radiation. Other advantages of the quartz tube are enumerated, such as freedom to breakage by heat, etc. The applications of such tubes in therapy are indicated. Note is made of the necessity of protecting the eyes against the radiation. The tubes are self-sterilising. B. J. L.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

228. *Absorption of Water by Colloidal Fibres.* **J. J. Hedges.** (Faraday Soc., Trans. 22. pp. 178–193, July, 1926.)—Theoretical considerations have shown that the process of water absorption by textile fibres depends on the relative humidity of the atmosphere if the latent heat of evaporation of water from the material is equal to the latent heat of evaporation of water in bulk. A series of determinations of the heat of wetting of wool were made. The wool was carefully purified from the grease and residues of the commercial cleaning processes. The heat of wetting was determined by measuring the rise of temperature caused by introducing a known weight of wool into the calorimeter and then causing the same rise of temperature by a resistance heater. The results showed that the heat of wetting of wool and the heats of absorption calculated from a form of Kirchhoff's equation are in fair agreement. A theory of the mechanism of the process is put forward. F. J. B.

229. *Absorption of Gases by Charcoal. Part I.* **R. A. Smith.** (Roy. Soc., Proc. 112. pp. 296–303, Sept. 1, 1926.)—This paper, of historical importance, consists of certain parts of a communication submitted to the Royal Society on Dec. 27, 1862, and read on Jan. 29, 1863. T. H. P.

230. *Two Contributions to the Theory of Concentrated Solutions.* **W. Heitler.** (Ann. d. Physik, 80. 7. pp. 629–671, July 29, 1926.)—Part I discusses the theory of hydratation. The molecules of solvent and dissolved substance are here regarded as arranged in a lattice, and the deviations from the laws of dilute solutions are explained on the basis that in the vicinity of a dissolved molecule a number of places are withheld from other dissolved molecules or rendered improbable by the force field, whereas this does not obtain for molecules of the solvent. The latter in the vicinity of the dissolved molecule are distinguished by no remaining alterations of the others. The forces between dissolved molecules and those of the solvent have no direct influence upon the behaviour of the solvent, but act only for an equal probability of disturbed arrangements.

Part II deals with the thermodynamics of binary mixtures, and an expression is developed for the mutual potential energy between any two molecules. The cases are then considered of two molecules of the same or different species orientated together, following which the behaviour of the mixture is derived by simple thermodynamic means. Simple relationships are also derived for vapour-pressure and miscibility and compared with experimental data.

An appendix contains an investigation of the special vibrations of a mixture necessary for specific heat determinations. H. H. Ho.

231. *Freezing of Gelatine Gel.* **T. Moran.** (Roy. Soc., Proc. 112. pp. 30–46, Aug. 3, 1926.)—An experimental study is made of the microstructure and volume changes produced by the freezing of gels of various concentration, and a quantitative determination is made of the separated ice. The disposition of ice in the frozen gel and the extent of structural deformation in the gel are shown to depend on the freezing rate and gel

concentration. When gels containing over 12 % gelatine are frozen slowly, there is a well-defined separation into ice and a more concentrated gel, the concentration of the latter being determined by the temperature. The existence of this phase equilibrium between ice and gel is used to determine the state of the water in iso-electric and acid gels. A. B. C. L.

232. *Microscopic Study of the Freezing of Gel.* **W. B. Hardy.** (Roy. Soc., Proc. 112. pp. 47–61, Aug. 3, 1926.)—Illustrations are given of the gel-structures visible after freezing and subsequent thawing. With gels of from 2 % to 40 % exposed to temperatures from − 6° C. to − 13·5° C. freezing is intermittent with the separation of a solid solution. In gels of less than 2 % freezing is always disseminated and very rapid, with the separation of crystals of pure ice. Gels of from 15 % to 40 %, when exposed to − 19° C., show disseminated freezing, with the formation of minute spheres of ice. It is concluded that the current conception that the spongy structure found in gels after freezing and thawing is due to crystals of ice is wrong, but that this spongy structure is due to the de-solution on rise of temperature and fall of pressure of the solid solution. Neither the optical properties nor the behaviour on thawing of the ice phase support Moran's suggestion that it is at any stage a mixture of ice crystals and particles of dehydrated gel. A. B. C. L.

233. *Origin of the Electrical Charge on Small Particles in Water.* **T. Alty.** (Roy. Soc., Proc. 112. pp. 235–251, Aug. 3, 1926.)—In continuation of earlier work [Abstract 242 (1925)], the electrical charge on an air bubble in water is measured under various conditions, and an examination is made of the mode of formation of this surface charge. For bubbles ranging in diameter from 2·0 to 0·2 mm. the total charge is independent of the diameter when equilibrium conditions obtain at the surface. The constitution of the surface layer is examined theoretically, and a new method of measuring the potential difference between the surface and the interior of the liquid is suggested. T. H. P.

234. *The Influence of Lyophilic Colloids on the Precipitation of Insoluble Salts. Gelatine and Silver Chromate.* **T. R. Bolam** and **Mary R. MacKenzie.** (Faraday Soc., Trans. 22. pp. 151–177, July, 1926.)—Measurements are made of the minimum concentrations of gelatine which, under different conditions, are necessary to prevent precipitation of silver chromate by the interaction of equivalent solutions of silver nitrate and potassium chromate of varying concentrations. The removal of calcium from the gelatine is found to be without effect on the inhibiting power of the gelatine, but its efficiency increases with increasing acidity. Measurements on diffusion show that the silver chromate present in gels containing sufficient gelatine to prevent its precipitation diffuses like a crystalloid and that the silver and chromate ions diffuse independently. There is no evidence of the presence of silver chromate in the colloidal state. Electrometric determinations show that the silver ion concentration in mixtures of silver nitrate, potassium chromate and gelatine may be much greater than in saturated aqueous solutions of silver chromate. There is found to be an optimum concentration of gelatine for each concentration of silver chromate, and more or less gelatine leads to a decrease of the silver ion. In mixtures where precipitation occurs the silver ion concentration falls at a rate which may be very slow, and depends upon the relative concentration. The conductivities of the mixtures are measured and confirm the e.m.f. results. Gelatine reduces the conductivity of aqueous solutions of silver nitrate, potassium chromate and potassium nitrate, the effect being much greater with the first two than with the last salt. It is concluded that when equivalent solutions of silver nitrate and potassium chromate are mixed in presence of gelatine, the latter removes a portion of the salts from solution and maintains the remaining silver chromate in a state of supersaturation. The results support Ostwald's theory of the Liesegang ring formation with silver chromate.

J. N. P.

235. *Solubility in Binary Mixtures of Liquids.* **T. Disselkamp.** (Zeits. phys. Chem. 123. pp. 99–110, Sept. 6. 1926).—In order to test Dolezalek's theory [see G. C. Schmidt, Abstract 2468 (1926)], whether too high a vapour pressure of binary mixtures indicates dissociation, and too low a vapour pressure indicates association, the author dissolves anthracene in binary mixtures of acetone, alcohol, benzene, toluene, chloroform, carbon disulphide and carbon tetrachloride, and determines the solubility at temperatures up to 105° by the method of Alexejew [see Pleuger, Abstract 1501 (1925)]. He finds that the solubility curve in normal liquids is analogous to the vapour-pressure curve in agreement with Dolezalek, and that in such mixtures the change in solubility is proportional to the change in the vapour pressure for the same temperature. In the presence of anomalous liquids (alcohols and acids), the two curves deviate strongly from one another; the relations are, however, too complicated to test the theory of Dolezalek. The assumption of Skirrow and Christoff, that there is a relation between the surface tension and the solubility of gases in liquid mixtures, is not confirmed.

H. B.

236. *Solvate Formation.* **M. S. Burr.** (Leeds Philosoph. and Lit. Soc., Proc. 1. pp. 74–80, Jan., 1926.)—An exponential relationship is deduced representing the solubility of 2 : 4-di-nitrotoluene in aqueous solutions of H_2SO_4 of concentrations between 84·5 % and 95 % H_2SO_4. Similar equations appear to be valid for other nitro compounds, and may be explained by assuming that the solute forms, with the better solvent, a continuous series of solvates in equilibrium with a certain amount of free solute. The application of the equation may be complicated by the formation of compounds between the two constituents of the solvent, except where the compound is sharply defined, as, for example, sulphuric acid monohydrate.

A. B. C. L.

237. *Free Energy of Hydration of Ions.* **T. J. Webb.** (Nat. Acad. Sci., Proc. 12. pp. 524–529, Aug., 1926.)—The formula of Born [see Latimer, Abstract 2472 (1926)] for the heat of hydration of ions, considers the total hydration effect to be of electrostatic origin. The author defines the r as the effective radius of the cavity surrounding the ion in which there are no solvent molecules, the r being several times larger than the radius of the electronic structure of the ion. Both r and the dielectric constant ε of the solvent (water) at the respective temperature probably have temperature coefficients; the ε is not constant in the immediate neighbourhood of an ion, and falls at about 1 Å. from the ion almost to the value corresponding with the optical polarisability of the medium [see Sack, Abstract 1654 (1926), and Walden and others, Abstract 1730 (1925)]. The energy change is a free energy change because it represents the electric work to be obtained at constant pressure and temperature from charging a condenser in water and subsequently discharging it in vacuum, and is not equal to the total energy change on account of the temperature coefficients mentioned. The difference between the free energy of hydration and of alcoholation is small, amounting to about 3 kg.-cal. per mol. of ions, but this difference is important for the differences in the activities of ions in different solvents. On these assumptions the author calculates the r for many ions, and finds them to agree with those of Wasastjerna and of W. L. Bragg [Abstract 2226 (1925)], those of the latter being by about 0·47 Å. smaller, for the radii of ions in crystals; the author's value for S^{--} (4·12) is, however, exceptionally high. Particulars of the calculations of the electron affinities are to follow. H. B.

238. *Iron Silicide.* **F. Körber.** (Zeits. Elektrochem. 32. pp. 371–378, Aug., 1926. Paper read before the Deut. Bunsen Gesell., Stuttgart, May, 1926.)—The equilibrium diagram for the iron-silicon alloys was revised, and the influence of the silicon content on the transition points of iron were determined. The constitution and structure of the iron silicon alloys were determined by the microstructure and by X-ray spectra. The equilibrium diagram indicates the existence of three silicides of iron, Fe_3Si_2, FeSi, and $FeSi_2$. The influence of the silicon content on the transition points of iron and its significance for the constitution of the rich iron mixed crystals, and for the problem of the polymorphism of iron was discussed. The technical importance of the iron-silicon alloys, especially as regards their electrical properties and uses, was indicated.

F. J. B.

239. *Mechanism of Reactions Photosensitised by Mercury Vapour.* **A. L. Marshall.** (J. Phys. Chem. 30. pp. 1078–1099, Aug., 1926.)—The available data on the absorption by Hg vapour of light of wave-length 2536·7 Å. are discussed, and measurements of the extinction of fluorescence in Hg vapour in the presence of various foreign gases are tabulated. An experimental method is devised for measuring the amount of energy absorbed by Hg vapour from a water-cooled quartz Hg arc., and a formula is developed for calculating the total energy radiated by a quartz Hg arc. Quantitative data, including the temperature coefficient, are obtained for the absorption by Hg *in vacuo*, and with H and N respectively at one atmosphere pressure. Hydrogen peroxide is shown to be the first isolatable product of the photochemical reaction between H and O when sensitised by Hg vapour, the mechanism of the reaction being represented by the equations: $Hg' + H_2 = 2H + Hg$; $H + O_2 = HO_2$; $HO_2 + H_2 = H_2O_2 + H$; $2H_2O_2 = 2H_2O + O_2$. The maximum yield measured for a mixture of $2H_2 + O_2$ is 6·6 molecules of H_2O_2 formed per quantum of 2536·7 Å. absorbed, the corresponding figure for the reaction $CO + H_2 = HCOH$, using a mixture of 37 volumes of CO and 34·6 volumes of H_2 being 6 molecules per quantum. It is emphasised that these values for the quantum yield represent minimal values, and that the application of further corrections would increase the length of the chains. It is hence considered that these reactions must have some "chain mechanism" and that the Einstein-Stark photochemical equivalence law does not hold It is noted that, under optimum conditions, with an energy input of 120 watts into the Hg arc, 0·39 % is absorbed by the reacting system.

A. B. C. L.

240. *Rate of Reaction in Chemical Changes Involving Atoms.* **M. Bodenstein.** (Preuss. Akad. Wiss. Berlin, Ber. 13, pp. 104–114, 1926.)—From researches on reactions between gases, which take place in the dark as well as in the light, it is found that in changes involving two atoms, *e.g.*, $Br + Br = Br_2$, or an atom and a molecule, *e.g.*, $Cl + Cl_2 = Cl_3$, considered as a step in the reaction $Cl_2 + CO \rightarrow COCl_2$, reaction takes place at practically every collision, whereas in the case of reaction between two molecules, the number of molecules involved in the change is small in comparison with the number of collisions. B. W. C.

241. *Some Chemical Reactions produced by β and γ Rays on Vapours.* **J. Errera and V. Henri.** (J. de Physique et le Radium, 7. pp. 225–229, Aug., 1926.)—The action of radium bromide contained in glass tubes which absorbed the α-rays was observed by photographing at intervals the ultra-violet absorption spectra of the vapours. The probable action of the rays on chlorobenzene is to cause polymerisation of the molecule. When the rays act on a mixture of chlorobenzene and hydrogen, the aromatic nucleus is hydrogenated; it is not formed of benzene. The effect on a mixture of benzene and air or oxygen is to form phenol, and the number of molecules of phenol so formed is at least sixty times the number of ions produced by the rays. No modification is caused by the rays in the position, intensity or structure of the absorption bands in the spectra of benzene, chlorobenzene or phenol vapours. G. E. A.

242. *Influence of Some Radioactive Elements on the Catalytic Activity of Certain Proteo-Bismuthic Precipitates.* **E. Laborde, J. Bressolles and L. Jaloustre.** (Comptes Rendus, 183. pp. 354–356, Aug. 2, 1926.)—Experiments are carried out on the lines of those recorded by Maubert, Jaloustre and Lefay [see Abstract 1980 (1925)], but with the introduction of a suitable radioactive element into the bismuth solution employed. Successive variations are made in the nature and concentration of the radioactive element and the proportion of proteo-bismuthic combination involved in the catalytic decomposition of oxygenated water. The results obtained are tabulated and a general increase in catalytic activity is indicated. It is suggested that this may be associated by a greater activity, on the part of these substances, when functioning as spirillicides. A. B. C. L.

243. *Kinetic Laws of Homogeneous Catalysis.* **E. Spitalsky.** (Zeits. phys. Chem. 122. pp. 257–286, Aug. 9, 1926.)—The author develops the views of E. Fischer, Henri and Michaelis on the intermediate-products theory of homogeneous catalysis with special regard to the fermentation of saccharose. The almost instantaneous formation of the intermediate products is itself reversible but subject to decomposition and relatively slow irreversible reaction with third bodies, the rate of the whole catalysis being proportional to the concentration of those products, and not to the concentration of the original substance (substrate). The conception of the chemical order of a catalytic reaction (the number of molecules entering into the formation of the intermediate product) must be distinguished from the kinetic order of the reaction, *i.e.*, the mathematical form of its rate curve. A kinetic reaction of order *n* may, according to the affinity constant of the catalyst with respect to the substrate, proceed in accord with various equations of orders 0 to *n*. The temperature influence will mainly show in the order of the reaction. The secondary catalysts or activators (mostly $H^{\cdot}$ or OH'-ions) will influence either the time rate or the order, according as they affect only the stability of the intermediate products or take part in their reversible formation. Only in very special cases can the simultaneous effect of two catalysts be additive. Owing to the possibility of the simultaneous formation of various intermediate products the relations will generally be complicated, and highly-complex catalytic reactions are more common than was believed, partly because it was erroneously assumed that normal catalytic reactions must be ruled by integer power laws. H. B.

244. *Rate of Dissolution of Aluminium.* **M. Centnerszwer** and **W. Zablocki.** (Zeit. phys. Chem. 122. pp. 455–481, Aug. 20, 1926.)—The electric potential of aluminium according to Smits [Abstract 229 (1925)] and Gerding (intermediate between magnesium and manganese) does not concord with its behaviour in mineral acids and in alkaline solutions; only from the latter does aluminium reduce zinc and lead. The peculiarities studied by the authors on bars and rods of aluminium (containing a little iron and silicon) are ascribed to a passive surface film, which passes continuously into the metallic nucleus, of a thickness more than molecular of 30 to 84μ, varying with the surface treatment (polishing with emery or on the lathe, treatment with metal polish, nitric acid, potassium iodide, hydrochloric acid, etc.). After an induction period, during which the rate of dissolution in acids increases, the rate keeps fairly constant. The behaviour of the metal in hydrochloric acid of increasing concentration (in which the thickness of the passive film remains unchanged, whilst the velocity constant increases rapidly) is best explained on the view of Hantsch, that the reaction takes place, not between the hydrogen ions, but between the undissociated molecules of the acid and the aluminium atoms. The view is supported by the observations that the rate of dissolution is hardly affected by the rate of stirring, that it depends upon the affinity of the aluminium to the anion of the acid (not upon the degree of dissociation), and that it is increased by the addition of chlorides to the hydrochloric acid, whilst sulphates and nitrates retard it. The temperature coefficient of the rate of dissolution is 1·7 to 2·4 per 10° rise of temperature as in the case of true homogeneous reactions. The dissolution of aluminium in alkali is purely ionic: $Al + OH' + H_2O = AlO_2 + 3H_2O$. H. B.

245. *Caking of Powders before Fusion (Iron Oxides).* **J. A. Hedvall.** (Zeits. phys. Chem. 123. pp. 33–85, Sept. 6, 1926.)—The author compresses dry powders (iron oxides) into small cylinders, heats these in currents of air or CO, up to 1268°, observes the contraction and increase of compressive strength, and discusses the physical and chemical processes with respect to grain size, temperature, period of heating and initial compression; caking owing to hydration is not referred to. The materials used are Fe_2O_3 and Fe_3O_4, chemically prepared or minerals, alone or mixed with CaO and SiO_2. There is an increase in strength at temperatures far below fusion, due to both shrinkage and recrystallisation and further to chemical reactions; it is futile to distinguish with Kühl between fritting and sintering (without or with incipient fusion). The influence of the length of the heating period is strong at low temperature when recrystallisation can take place; even with a small initial compression some recrystallisation was observed after half an hour's heating; small grain and irregular shape favour cohesion. Both the chemical reactions, $2Fe_3O_4 + \frac{1}{2}O_2 = 3Fe_2O_3$, and $3Fe_2O_3 + CO = 2Fe_3O_4 + CO_2$ give mechanically stronger products; this is very important for the briquetting of magnetite (Gröndahl) at temperatures above 1100°. In the presence of SiO_2 silicates are formed already below 900°, and even 500° in a nitrogen atmosphere; CaO seems to replace the FeO in $FeO \cdot Fe_2O_3$; both these "displacement reactions" are considered technically important. H. B.

246. *Ionisation in Reacting Gases.* **A. K. Brewer.** (Nat. Acad. Sci., Proc. 12. pp. 560–564, Sept., 1926.)—The similarity of the equations connecting rate of chemical action and rate of thermionic emission respectively with temperature is discussed in relation to measurements of ionic emission during chemical reaction. The reaction is that of oxidation of a number of gases and vapours. It is suggested that the mechanism of chemical action is the ionisation of gas molecules by combined image and contact forces. F. S.

247. *Vapour Pressures and Base Exchange between Zeolites and Permutite.* **V. Rothmund.** (Zeits. Elektrochem. 32. pp. 367–371, Aug., 1926. Paper read before the Deut. Bunsen Gesell., Stuttgart, May, 1926.)—The paper forms a portion of a symposium on the chemistry of silicon, and the various aspects of the subject are reviewed and discussed in a critical manner. The influence of the exchange of the bases present in the soil upon the growth of plants is explained on the lines of the existence of zeolites in the soil. F. J. B.

248. *Determination of the Velocity-Constant of a Unimolecular Reaction.* **E. A. Guggenheim.** (Phil. Mag. 2. pp. 538–543, Sept., 1926.)—The velocity constant k is usually determined by plotting the log $(v_\infty - v)$, against time t, where v and v_∞ are the initial and final readings. The end point of the reaction is frequently not observable and has to be found by extrapolation. R. C. Smith [*ibid.*, 1. pp. 496–499, Feb., 1926] therefore proposed to select three points such that the time interval $\Delta t = t_2 - t_1 = t_3 - t_2$; then v_∞ can be found as an explicit function of v_1, v_2, v_3, but the v values will themselves be uncertain. The author takes n readings $v, v_i \ldots v_n$ at times $t_1, t_i, \ldots t_n$ (without restrictions as to interval), and then n more readings $v'_1 \ldots v'_i \ldots v'_n$ at times $t_1 + \tau, t_i + \tau$, etc., and deduces the equation $kt_i + \log_e(v'_i - v_i) = \log_e\{(v_\infty - v_0)(1 - e^{-k\tau})\} = \text{constant}$. The method has proved accurate at the Copenhagen Polytechnic when τ is chosen large; every reading is used once only, and there is no extrapolation. H. B.

249. *Influence of the Electrodes on the Formation of Ozone at Low Pressures in the Electrical Discharge.* **P. T. Newsome.** (Am. Chem. Soc., J. 48. pp. 2035–2045, Aug., 1926.)—Measurements are made of the formation of ozone by subjecting to a silent discharge oxygen at a low pressure and with electrodes of large area, so that most of the reaction occurs at the electrodes. Oxygen is passed through the discharge chamber in which a constant current of two milliamps. at 2200 volts is maintained and into potassium iodide solution to absorb the ozone. The yields are determined as M/n ratios, where M is the number of molecules reacting and n the number of electrons reaching the electrodes. The pressures are varied from 14 mm. to 33 mm. The values of M/n decrease with decreasing pressure and approach to a constant value of 0·5, which is the value corresponding to Faraday's law. The yield is largely influenced by the material of the electrode, the efficiency decreasing in the order, copper, gold, silver, aluminium. The results obtained are in accord with the hypothesis that part of the ozone formed in the discharge is decomposed at the positive electrode, and that different metals possess varying catalytic effects. With certain electrodes the yield of ozone increases as the electrodes become aged, which is attributed to the formation of a film which protects the ozone from the decomposing action of the positive electrode. J. N. P.

250. *Fluorescence and Reaction-Velocity.* **J. Perrin and (Miss) Choueroun.** (Comptes Rendus, 183. pp. 329–331, Aug. 2, 1926.)—The relation is discussed between the velocity of reaction, depending, as in Arrhenius's theory, on the concentration and mean life of active molecules and the fluorescence caused by the absorption of light quanta with the production of active molecules, which in turn re-assume the ordinary state with the re-emission of light. The concrete case of the destruction of methylene blue and new methylene blue by glycerine at high dilution is taken as an example. A. B. C. L.

251. *Equilibrium of Heterogeneous Systems including Electrolytes. Part I. Fundamental Equations and Phase Rule.* **J. A. V. Butler.** (Roy. Soc., Proc. 112. pp. 129–136, Aug. 3, 1926.)—W. Gibbs, in his memoir on the equilibrium of heterogeneous systems, obtained the conditions of equilibrium in such systems. In the case of electrolytes, however, his results were comparatively meagre, owing to the facts that (1) cases of equilibrium (even for open circuit) are quite exceptional; (2) the difference of potential in electrolyte and electrode involves the consideration of quantities apparently incapable of physical measurement. The first of these reasons is no longer valid, and the author has extended Gibbs' method to systems containing electrolytes by the introduction of another variable, the electric potential. The general conditions of equilibrium are thus obtained and a modified form of the phase rule for neutral masses containing electrolytes is given. A discussion of its application to galvanic cells follows. T. B.

252. *The Mercurous Sulphate Electrode.* **S. Makio.** (Electrot. Laborat. Tokyô, Japan, Researches, No. 174. [20 pp.], 1926.)

253. *Electromotive-Force Measurements in Aqueous Solutions of Hydrochloric Acid containing Sucrose.* **G. Scatchard.** (Am. Chem. Soc., J. 48. pp. 2026–2035, Aug., 1926.)—The electromotive forces of the cell Hg/HgCl, KCl (satd.)/HCl, sucrose, AgCl/Ag with flowing junction and of the cell Pt., H_2/HCl, sucrose, AgCl/Ag have been measured at 25° with 0·1012 N acid and sucrose concentrations ranging from 0 to 700 gm. per litre. The potential falls with increasing concentration of sucrose which is related to the change in concentration due to the change in the total number of moles per litre, the change in the free energy increase of the hydration of hydrogen ions or formation of H_3O' due to the change in the activity of water, and the effect of the change in the dielectric constant on the activity coefficient and on the activity at infinite dilution. The influence of these different factors is considered quantitatively. A closer agreement of the e.m.f. values between measurement and theory is obtained by allowing for hydration of the sucrose molecules. J. N. P.

254. *Location of the Electromotive Force in a Photoactive Cell containing a Fluorescent Electrolyte.* **C. C. Murdock.** (Nat. Acad. Sci., Proc. 12. pp. 504–508, Aug., 1926.)—According to Hodge [Abstract 695 (1909)] and Goldmann [Abstract 265 (1909)] it is necessary to illuminate the actual boundary between electrode and solution in order to observe an e.m.f. in an illuminated electrolytic cell containing a fluorescent electrolyte, but Grumbach [see Abstract 1772 (1925)] found that, if sufficiently dilute solutions are used, an e.m.f. may be obtained when the light does not fall on the electrode. The results now given of measurements made with Goldmann's semi-transparent film-electrodes on glass and a 3 % absolute alcoholic solution of rhodamine-B, arranged so that the liquid flows along the surface on which the electrode is deposited, and may be illuminated through or on either side of the electrode, indicate that the photoactive e.m.f. in the Goldmann cell is due partly to action by light on the fluorescent electrolyte in which the electrode plays no active part. Concerning a possible e.m.f., in the production of which the illumination of the electrode is necessary, the results obtained are not conclusive. T. H. P.

255. *Ionisation of Weak Electrolytes.* **D. A. MacInnes.** (Am. Chem. Soc., J. 48. pp. 2068–2072, Aug., 1926.)—Calculations based mainly on Kendall's measurements [Abstract 1781 (1912)] show that the law of mass action is valid for a series of organic acids of various strengths throughout the complete range of concentrations for which conductivity measurements have been made, provided (1) that the degrees of ionisation are computed in a manner which allows for inter-ionic attraction, and (2) that the resulting ionic concentrations are multiplied by the appropriate activity coefficients. The agreement hitherto observed with Ostwald's dilution law with weak electrolytes and with the lower concentrations of "transition" electrolytes is found to be due to compensation of two effects. Arrhenius's method for calculating extents of dissociation gives results which are too low, and the activity coefficients have been assumed to have the value one, whereas at all low concentrations such coefficients are less than one. T. H. P.

256. *Inter-Ionic Attraction Theory of Ionised Solutes. VI. Ionisation and Ionisation Constants of Moderately Ionised Acids.* **M. S. Sherrill** and **A. A. Noyes.** (Am. Chem. Soc., J. 48. pp. 1861–1873, July, 1926.)—More accurate values for the ionisation of moderately ionised acids than those obtained from the ratio Δ/Δ_0 are calculated, assuming that the mobility and the activation of a given kind of ion are determined by the ionic strength of the solution and not dependent on the nature and concentration of the separate ions which give rise to this ionic strength. The ionisation constant is given by $K = \dfrac{L_H a_A \gamma^2 c}{1 - \gamma}$, when L_H and a_A are the activations of the two ions at the prevailing ionic strength, etc. The method has been employed satisfactorily to determining the ionisations and ionisation constants of the first hydrogens of phosphoric and sulphurous acids and of the second hydrogen of sulphuric acid. B. W. C.

257. *Oscillographic Study of Anodic Polarisation.* **V. H. L. Searle.** (Phil. Mag. 2. pp. 733–740, Sept., 1926.)—Results are given of measurements of the rate of formation of anodic films by means of direct current and of the degree of recovery of the cell following cessation of the current, the electrolyte used being a saturated ammonium phosphate solution with a nickel kathode in combination with an aluminium anode. The rate of polarisation is very rapid at first, but the final value of the current is reached only slowly and then remains unchanged for a number of hours. As the voltage is increased and the anode surface decreased, the time elapsing before steady conditions are attained is greatly lengthened. The degree of recovery depends on the time during which the current is interrupted. T. H. P.

258. *Beer's Law for Dilute Electrolytes.* **H. v. Halban and J. Eisenbrand.** (Zeits. phys. Chem. 122. pp. 337–348, Aug. 20, 1926.)—It has been shown by previous workers that Beer's law does not hold, even as a first approximation, for dilute electrolytes. A very careful investigation made on potassium nitrate in water solution and salicylic acid in alcoholic solution shows that the deviations from Beer's law found by the previous workers, Suhrmann and Huppert [Abstract 2463 (1925)], are the result of experimental errors, and that when these errors are removed Beer's law holds for the cases under consideration. The small decrease in the extinction coefficient observed in the case of salicylic acid with increasing dilution is partially due to dissociation. F. J. B.

259. *New Type of End-Point in Electrometric Titration and its Application to Iodimetry.* **C. W. Foulk and A. T. Bawden.** (Am. Chem. Soc., J. 48. pp. 2045–2050, Aug., 1926.)—The electrometric titration of iodine by sodium thiosulphate or sodium arsenite is conducted by a system in which two platinum electrodes are maintained at a potential of 10 to 15 millivolts when, on reaching the end-point of the titration, a deflection of the galvanometer, which is inserted in the circuit, occurs. The applied potential is balanced by the back e.m.f. of polarisation, and under these conditions a sharp end-point occurs in the titration of all systems in which a sharp transition from the polarisation of at least one electrode to the complete depolarisation of both of them coincides with the end of the reaction. Polarisation is assumed to be due to oxygen adsorbed on the anode and hydrogen on the kathode, and that the anode can, therefore, be depolarised by a suitable reducing agent and the kathode by a suitable oxidising agent. A description is given of an arrangement which depends upon a concentration chain, composed of two potassium iodide solutions connected by a salt bridge, for the necessary impressed potential between the electrodes. Iodimetric titrations can be made in the weaker of the two solutions without the use of a battery. [See Abstract 1268 (1925).] J. N. P.